PB81-110975

Seasonal Fluctuations of Major Diatom Species at Five Stations Across Lake Michigan May 1970-October 1972

Michigan Univ., Ann Arbor

Prepared for

Environmental Research Lab.
Duluth, MN

Jul 80

U.S. Department of Commerce
National Technical Information Service
NTIS

United States
Environmental Protection
Agency

Environmental Research
Laboratory
Duluth MN 55804

EPA-600/3-80-066
July 1980

Research and Development

PB81-110975

EPA

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TECHNICAL REPORT DATA
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1. REPORT NO. EPA-600/3-80-066	2.
3. RECIPIENT'S ACCESSION NO. PB81 110975	
4. TITLE AND SUBTITLE Seasonal Fluctuations of Major Diatom Species at Five Stations Across Lake Michigan, May 1970 - October 1972	5. REPORT DATE JULY 1980 ISSUING DATE.
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Ruth E. Holland	8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Department of Atmospheric and Oceanic Sciences The University of Michigan Ann Arbor, Michigan 48109	10. PROGRAM ELEMENT NO. 1BA769
	11. CONTRACT/GRANT NO. R805133
12. SPONSORING AGENCY NAME AND ADDRESS Environmental Research Laboratory Office of Research and Development U.S. Environmental Protection Agency Duluth, Minnesota 55804	13. TYPE OF REPORT AND PERIOD COVERED Final 4/1/77 - 6/79
	14. SPONSORING AGENCY CODE EPA/600/03
15. SUPPLEMENTARY NOTES	

16. ABSTRACT

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17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Phytoplankton Nutrients	Lake Michigan	06F

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS (This Report)	21. NO. OF PAGES
Release to Public	Unclassified	
	20. SECURITY CLASS (This page) Unclassified	22. PRICE

EPA Form 2220-1 (9-73)

★ U.S. GOVERNMENT PRINTING OFFICE: 1980--657-165/0074

EPA-600/3-80-066
July 1980

SEASONAL FLUCTUATIONS OF MAJOR DIATOM SPECIES AT FIVE STATIONS ACROSS LAKE MICHIGAN, MAY 1970 - OCTOBER 1972

by

Ruth E. Holland
Department of Atmospheric and Oceanic Sciences
The University of Michigan
Ann Arbor, Michigan 48109

Grant No. R-805133-01-1

Project Officer

Nelson A. Thomas
Large Lakes Research Station
Grosse Ile Laboratory
Grosse Ile, Michigan 48138

ENVIRONMENTAL RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
DULUTH, MINNESOTA 55804

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FOREWORD

The Environmental Protection Agency has the responsibility to develop understandings of the various components of the Great Lakes ecosystem. The Great Lakes, because of their great size and complexity, require studies that often span a full year with numerous samplings. The collection of data through winter periods is quite difficult and have been limited. This study utilized a source of transportation that provided sampling through the winter periods on frequent intervals. Through the documentation of phytoplankton population during the winter period, greater understanding can be obtained on the species changes that may be taking place in Lake Michigan. The study of phytoplankton during the winter period provides insight into both population dynamics as well as factors controlling population growth. Too often records of biological populations are not adequately documented so that changes in the ecosystem can be adequately accessed. It is hoped this study will provide a documentation of phytoplankton, especially diatoms, throughout the winter period.

Norbert Jaworski
Director
Environmental Research Laboratory
Duluth, Minnesota

ABSTRACT

From 27 May, 1970 to 4 October, 1972, we collected water samples from five stations on a transect across Lake Michigan from Milwaukee, Wisconsin to Ludington, Michigan. At all stations in the three years sampled, diatoms reached their highest numbers in late spring or summer. These periods of greatest abundance of total diatoms were the result of the rapid growth of one or two species. Stephanodiscus hantzschii was the dominant species at Station 1, off Milwaukee, and Rhizosolenia eriensis was the dominant species or one of the predominant forms at the other 4 stations. Cyclotella stelligera was the dominant diatom when highest yearly numbers were reached at Stations 3 and 5 in August, 1972. Highest winter numbers were reached at Station 1 on 22 February, 1972 when total frustules were 960/ml, and Stephanodiscus minutus was dominant at all stations. Solar radiation appeared to be the limiting factor in the productivity of winter plankton.

There were differences between inshore and offshore stations. Mean concentrations of total phosphorus and some diatoms, such as Tabellaria flocculosa and Fragilaria crotonensis were higher, and mean concentrations of silica were lower at Stations 1 and 5 than at the offshore stations. Station 1, however, was most distinct. Mean concentrations of soluble reactive phosphorus, nitrate nitrogen, silica, chlorophyll, carotenoids, total phosphorus, and total diatoms were higher at Station 1 than at the other stations. Stephanodiscus hantzschii was consistently a seasonal dominant, and Fragilaria capucina was more abundant at Station 1 than at the other stations. Therefore, from both direct and indirect evidence, the water at Station 1 was more eutrophic than the water in the other areas, and reflected the continued input of nutrients from the Milwaukee area.

This report was submitted in fulfillment of Grant No. R-805133-01-1 by Ruth E. Holland (Beeton) under the sponsorship of the U.S. Environmental Protection Agency. This report covers a period from 1 April, 1977 to 30 June, 1979 and work was completed as of 3 July, 1979.

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ACKNOWLEDGMENTS

I gratefully acknowledge the cooperation of Mr. T. A. Winkel, Superintendent of Steamships, and the Chesapeake and Ohio Railroad. Drs. E. J. Fee, U. Zimmerman, and Mr. D. C. Rousar collected the car ferry samples and established methods for chemical determinations. Becky Glover drew the isometric projection graphs of the major diatom species. Samples were collected in conjunction with projects funded by the Wisconsin Sea Grant Program.

SECTION 1

INTRODUCTION

Harsh winter weather conditions have always made year-round sampling of the waters of the Great Lakes, especially offshore, hazardous and often impossible. Consequently, our knowledge of the winter offshore phytoplankton is very limited. For example, the material examined by Stoermer and Yang (1969) included only two samples taken in winter (12 January, 1966 and 27 January, 1967) from offshore waters. Other winter samples (December, January, February) cited in their publication were from collections made between 1881 and 1947 that were taken from nearshore waters in the vicinity of Chicago. Ahlstrom (1936) was the earliest investigator to make a comprehensive study of the open-lake plankton, but he examined samples taken only in warm-weather months. Other early investigators studied plankton of the nearshore waters in the vicinity of Chicago (Davis 1966). Holland (1969) studied the inshore and offshore waters of Lake Michigan, but only from April to November.

Winter sampling in the other Laurentian Great Lakes has also generally been confined to inshore waters. Notable exceptions have been the studies by Munawar and Nauwerck (1971), and Stoermer, Bowman, Kingston, and Shaedel (1975), but the authors of both investigations comment on the small number of sampling stations during parts of the winter or other sampling limitations because of severe winter weather.

Recent investigations have demonstrated significant differences between inshore and offshore waters in Lake Michigan which show that inshore environments are deteriorating at a much faster rate than the offshore environments (Federal Water Pollution Control Administration 1968a, b; Holland 1968, 1969; Holland and Beeton 1972; Fee 1971; Beeton and Barker 1974). Recognition of this fact is important since, in the past, many of the conclusions concerning changes in the biota and environments of the Great Lakes have been based upon data from water intakes sampling inshore water (Davis 1964; Beeton 1969). Moreover, many engineering studies dealing with water supply and disposal of municipal, industrial, and thermal waste have been based upon the assumption that the entire volume of the lake was available for dispersion of pollutants.

The present study is valuable largely because samples were taken year-round, at frequent intervals, and from inshore as well as offshore (including mid-lake) waters.

Data from this transect on six sampling dates were analyzed earlier (Holland and Beeton 1972).

SECTION 2

CONCLUSIONS

At all stations, diatoms reached their highest numbers in either late spring or summer generally as the result of the rapid growth of one or two species. One of these species, Rhizosolenia eriensis H. L. Smith, has not been listed as a dominant diatom in Lake Michigan since the study by Ahlstrom (1936); since its period of abundance is relatively short, investigators may not have sampled frequently enough to find it during peak abundance.

Highest winter numbers of total diatoms (960/ml) were reached at Station 1 on 22 February, 1972 when Stephanodiscus minutus Grun. ex Cleve and Müll. was the dominant species at all stations. This winter peak is similar to one observed by Chandler and Weeks (1945) in western Lake Erie. The size and duration of such cold weather peaks appear to be limited by the amount of solar radiation reaching the plankton.

There were differences between inshore and offshore stations, but Station 1 was most distinct and reflected the continued input of nutrients from the Milwaukee area.

SECTION 3

RECOMMENDATIONS

Future studies to establish seasonal fluctuations of phytoplankton or even relative abundance of species in a lake should incorporate sampling intervals as short as possible so that species with limited periods of abundance are not missed; sampling at intervals of one week is recommended.

Future studies should take into account the possible differences among different parts of the lake. Inshore areas differ from offshore areas and the inshore areas of this study differed from each other.

Scientists should report results in absolute numbers rather than terms of relative abundance so that comparisons among studies can be made and so that future investigators will have a quantitative data base upon which they can make conclusions of possible changes in species abundance.

Diatoms should be identified at magnifications appropriate to frustule size; since small centrics are sometimes as small as 2.5μ in diameter, the highest magnification (usually approximately 1000x) is advised.

SECTION 4

MATERIALS AND METHODS

In May 1970, we began to determine the spatial and temporal extent of differences in the inshore and offshore planktonic diatom populations of Lake Michigan. We sampled from a water-cooling intake at a depth of about 4 m of the Chesapeake and Ohio Railroad ferry Badger at five locations on its route between Milwaukee, Wisconsin and Ludington, Michigan (Figure A-1). The sampling depth was close to the optimum depth for production in the epilimnion in a previous study (Holland 1969). The nearshore stations were located about 4.8 km from the harbor breakwalls; one offshore station was located in midlake; and the two remaining offshore stations were located half way between the midlake station and each nearshore station.

Diatoms were cleaned and then identified and counted at 1000x as described by Holland (1969). Major diatoms (those at one time or another making up 5% or more of total frustules) are discussed. Synedra filiformis Grun. is not discussed because it was important only on 26 June 1970 (Holland and Beeton 1972).

Abundance data for major diatom species are given in Tables B-2 through B-6 in the appendix.

Many of the samples from the earlier part of the study deteriorated because of a chemical reaction between Lugol's preservative and the metal caps of the bottles in which the samples were stored. In the isometric projection graphs, broken lines indicate that data are missing. A continuous recording thermometer monitored temperatures of the intake water beginning 7 July 1970. Before that and during winter, temperatures of water samples were taken by stem thermometers.

Corollary data summarized in this report and the methods of determination are treated extensively by Fee (1971), Rousar (1973), and Claflin (1975).

SECTION 5

RESULTS

At all stations, diatoms reached their highest numbers in either late spring or summer (Figures A-2 and A-3). In 1970, this occurred on 26 June. Unfortunately, the July samples for this year deteriorated before being examined so it is not known whether populations continued to increase in July. Stephanodiscus hantzschii Grun. made up 82% of all diatoms at Station 1 on 26 June. Rhizosolenia eriensis was the dominant form at Stations 2, 3, and 4, making up 37%, 58%, and 74% of total diatoms respectively. At Station 5, the following forms predominated on this date: Rhizosolenia eriensis, Tabellaria flocculosa (Roth) Knudson; Fragilaria crotonensis Kitton; and Fragilaria construens (Ehrenb.) Grun. Total diatom abundance for 1971 and 1972 are plotted in Figures A-2 and A-3. In 1971, diatoms at Station 1 peaked on 25 May, and Stephanodiscus hantzschii again was the dominant species, making up 60% of the total. Total diatoms peaked on 16 June at Stations 2, 3, and 5, and Rhizosolenia eriensis was again the dominant form at Station 2 and 3, and co-dominant with Asterionella formosa Hassall at Station 5. The June peak at Station 2 was about 2/3 less than the peaks at Stations 1 and 3; no June peak was observed at Station 4. In 1972, diatoms peaked in spring only at Station 1 where the dominant species was Melosira islandica O. Müll. Highest populations for all stations that year were recorded in July at Stations 1, 2, and 4 and in August at Stations 3 and 5. As in the two previous years, at the time of greatest total abundance, Stephanodiscus hantzschii was the dominant diatom at Station 1 where it comprised 50% of the total. Rhizosolenia eriensis was the dominant form in the abundance peak at Station 2 on 9 July, and it was also the dominant diatom at Stations 3 and 5 on this date. This form reached its greatest numbers at Station 4 on 25 July when it made up 49% of total frustules during the greatest abundance peak there. Cyclotella stelligera Cleve and Grun. was the dominant diatom when highest yearly numbers were reached at Stations 3 and 5 on 16 August.

In addition to the major abundance peaks, there were sometimes moderate peaks during summer, fall, and winter. Fragilaria crotonensis and Cyclotella stelligera were generally dominant or one of the predominant forms during the minor warm weather increases. Fall was the period of least growth for diatoms, but Stations 1 and 4 experienced moderatly increased total numbers during October, 1971 when Fragilaria crotonensis was the dominant form at both locations. Total diatoms were moderately increased at Stations 1 and 5 during September, 1972 when Fragilaria crotonensis was again the dominant diatom.

Because of the dearth of information on winter plankton in Lake Michigan, these data are perhaps most interesting. Total diatoms reached 578/ml on 9 December, 1970 at Station 1 when Fragilaria crotonensis dominated. Stephanodiscus minutus was the dominant diatom at this station a month later on 6 January, 1971 when total frustules were 481/ml. Stephanodiscus minutus also was the major form during the slight January 1971 increase at Station 5. Unfortunately, the February data of this year for all but Station 2 are missing. Winter data for 1972 are complete for all stations, and total diatoms for all stations peaked on 22 February, when Stephanodiscus minutus dominated at all stations, making up between 37 and 47 percent of all diatoms (Figure A-4). Highest numbers were recorded at Station 1 with total cells at 960/ml.

Besides Stephanodiscus minutus, other important forms at Station 1 were Fragilaria construens, Melosira islandica, Stephanodiscus hantzschii, Melosira italica (Ehr.) Kütz., and Stephanodiscus alpinus Hust. ex Huber-Pestalozzi. At all other stations, Cyclotella stelligera was important, especially in offshore waters where it made up between 13 and 18 percent of total frustules. Stephanodiscus alpinus was present in moderate numbers at all stations as it had been in 1971; although this species is characteristic of the winter plankton, it should be noted that its highest numbers (111/ml) were found at Station 3 on 16 June, 1971.

During periods of greatest abundance of total diatoms, the peaks were generally the result of the rapid growth of one or two species. At Station 1, this specie was Stephanodiscus hantzschii, and at the other stations the species were Rhizosolenia eriensis and Cyclotella stelligera. These diatoms were responding to local conditions. Stephanodiscus hantzschii flourished in the inshore waters, especially off Milwaukee where nutrients were very high. Although Rhizosolenia eriensis was abundant at all the other stations, Stations 2, 3, and 5 had peak numbers of this diatom simultaneously during the summer of 1972 while peak numbers of Rhizosolenia eriensis at Station 4 were reached 16 days later. During the 1972 winter maximum, Stephanodiscus minutus peaked at all stations simultaneously, but the peaks were sustained at Stations 2 and 3.

Although each station exhibited some uniqueness, there was also a contrast between inshore and offshore areas (Holland and Beeton 1972). Mean concentrations of total phosphorus and some diatoms such as Tabellaria flocculosa and Fragilaria crotonensis were higher and mean concentrations of silica were lower at Stations 1 and 5 than at the offshore stations (Table B-1). Station 1, however, was most distinct. Mean concentrations of soluble reactive phosphorus, nitrate nitrogen, silica, chlorophyll, carotenoids, and total diatoms were all higher at Station 1 than at the other stations. Mean concentrations of total phosphorus were much higher there. Stephanodiscus hantzschii was consistently a seasonal dominant at Station 1; the only time it was the most abundant diatom at another station was on 27 May, 1970 at Station 5.

Fragilaria capucina Desmazieres, a form abundant in nutrient-rich southern Green Bay (Holland and Claflin 1975), was most abundant at Station 1. Hohn (1969) found that Fragilaria capucina increased dramatically in

western Lake Erie as the lake underwent eutrophication. It is considered a form characteristic of eutrophic waters (Huber-Pestalozzi 1942). From both direct and indirect evidence, therefore, the water at Station 1 is distinctly more eutrophic than the water in the other areas, and reflects the agricultural runoff and municipal discharge of the Milwaukee area, primarily through the Milwaukee River. The contrast between Station 1 and the other stations supports the contention that continued input of nutrients is necessary to maintain a given level of eutrophication (Beeton and Edmondson 1972). The Ludington area also receives runoff from the Pere Marquette River, but the discharge is not as rich in nutrients as that from the Milwaukee River and its effects are felt closer to shore (Holland 1969).

Fee (1971) and Rousar (1973), working on replicate samples from the car ferry stations, described a bimodal seasonal abundance of phytoplankton based upon primary productivity and pigment analyses but their work included no data from 1972. Claflin (1975) analyzed phytoplankton from replicate samples taken 6 October, 1971 - 27 October, 1972. He included primary productivity data and pigment analyses which show small peaks in February, 1972 which coincide with this study's winter diatom abundance peak for that year, and varying peaks for summer as well as for spring and fall. Claflin found a peak of non-diatom plankton in the fall ranging from approximately 1200 entities/ml at Stations 1, 2, 4, and 5, to about 4000 entities/ml at Station 3. It would thus appear that diatoms were the major producers in the fall. However, it is possible that much of the chlorophyll observed in the samples of Fee and Rousar in the fall originated in the subthermocline maximum observed by Brooks and Mortonson (1978) and was brought into upper waters as the thermocline began to be disturbed in the fall (Mortimer 1975).

There was no apparent consistent relationship among the corollary nutrient data and diatom species fluctuations. Moreover, these relationships would be most meaningful when the species becomes abundant during its exponential growth phase which we are only sometimes able to observe, because it is often interrupted by various perturbations.

SECTION 6

DISCUSSION

One of the striking findings of this study was the consistent peaks of abundance of Rhizosolenia eriensis at all but Station 1 (Figure A-5). For three consecutive years, it was the dominant or predominant form in spring or early summer. Rhizosolenia eriensis is abundant in Lake Superior (Holland 1965) and has declined to insignificance since the 1930's in Lake Erie (Hohn 1969). Huber-Pestalozzi (1942) characterized the environment of this species as deep lakes which tend toward oligotrophy. Its distribution and abundance at the car ferry stations also suggested that it grows best in relatively oligotrophic water. Tarapchak and Stoermer (1976) described it as being mesotrophic but intolerant of nutrient enrichment. Rhizosolenia eriensis has not been mentioned as a dominant species in Lake Michigan since Ahlstrom (1936), who said it was abundant in most collections and in a few samples, outnumbered all other organisms present.

I did not find this species to be a major diatom in my 1965 study of Lake Michigan (1969) but we were able to sample only twice between 9 June and 19 August (because our vessel was commandeered for another study) and it is very likely that we missed the relatively short period of maximum abundance of Rhizosolenia eriensis. This species was also found to have a "quick spurt" of abundance in Canadaigua Lake, New York, but in the fall rather than in the spring or summer (G. R. Wilcox, personal communication). It is quite possible that other investigators of Lake Michigan plankton have not found this diatom to be prominent because they have not sampled during the relatively short period when it is abundant. Rhizosolenia eriensis was found to be in exponential growth phase at Station 4 during the summer of 1972. The growth of this species paralleled an increase in temperature and a decrease in silica and soluble reactive phosphorus, and a very slight decrease in nitrate nitrogen (Figure A-6).

Cyclotella stelligera (called Cyclotella glomerata-stelligera, Holland 1965) is a dominant or predominant species during the summer in Lake Superior and is a dominant or predominant form during the summer at all but Station 1 on the car ferry transect (Figure A-7). This species, like Rhizosolenia eriensis, has declined to insignificance in western Lake Erie since the 1930's (Hohn 1969) while that lake has undergone accelerated eutrophication (Beeton 1965). On the car ferry transect, it was most abundant at the stations where nutrients were lowest, affirming the impression that this is a relatively oligotrophic form. At Station 3, during the summer of 1972, it was found to be in exponential growth phase. It is during this growth phase that relationships to physical and chemical variables should be most meaningful.

The growth of Cyclotella stelligera was found to parallel increasing water temperatures and to be inversely related to the ratio of silica to soluble reactive phosphorus (Figure A-8). The relationship between growth of this species and Si/P ratio is interesting in light of the work of Kilham and Kilham (1978) and Tilman (1977). They assume that silicate and phosphate potentially limit the growth rates of diatom species and propose that if one nutrient is kept constant and the other nutrient varied, the species growth rates will react in different, but predictable ways along the resource gradient. Their results of different optimum Si/P ratios for different species have been obtained under controlled laboratory conditions and have not included Cyclotella stelligera. Natural field conditions are much more complex, but trends between Si/P ratios and species in natural waters are worth examining. Stoermer and Yang (1969) found relatively low numbers of Cyclotella stelligera in their samples but they used a #20 mesh net for collectior which is not effective for capturing this diatom which is uncellular and may be as small as 2.5μ.

Stephanodiscus hantzschii was a dominant species once at Station 5, and consistently a seasonal dominant at Station 1 (Figure A-9). It has been found to be abundant in the spring by Munawar and Nauerck (1971) and by Stoermer et al. (1975) in Lake Ontario. Tarapchak and Stoermer (1976) described this as an eutrophic form in Lake Michigan and Huber-Pestalozzi (1942) described it as characteristic of strongly eutrophic water in Europe.

Fragilaria capucina was most abundant at Station 1 and slightly more abundant at Station 5 than at the offshore stations (Figure A-10). This species is abundant in eutrophic southern Green Bay (Holland and Claflin 1975) and has been associated with the eutrophication of Lake Erie (Hohn 1969).

The distribution of Melosira species between inshore and offshore waters was not as clearcut as in a previous study (Holland 1968). Melosira ambigua (Grun.) O. Müll. mentioned previously as a species associated with inshore waters was more abundant at the inshore stations but its numbers were generally low everywhere (Figure A-11). Maximum and mean values for Melosira islandica were highest at Station 1 and lowest at Station 5 (Table B-1). The abundance of Melosira italica at Stations 2 and 5 were similar. Lund (1954) suggested that turbulence may be necessary to keep Melosira species in suspension since Melosira italica (Ehr.) Kütz. subsp. subarctica O. Müll. practically disappeared from near-surface waters as Blelham Tarn stratified. In this study, Melosira islandica and Melosira italica were also suppressed during stratification (Figures A-12 and A-13). Thermal stratification (at 10 m) is generally established over the whole Lake Michigan basin by the end of June. From mid-August onward, the thermocline begins to descend while maintaining a steep gradient, and final mixing (overturn) takes place in December (Mortimer 1975). Small populations of Melosira ambigua, on the other hand, were sometimes maintained after stratification was presumably established. Direct effects on optimum growth may be a factor in the incidence of Melosira species. Stoermer et al. (1975) point out that most literature sources indicate that Melosira islandica reaches its maximum abundance at water temperatures of less that 12°C, and this was indeed the case in this study.

Tabellaria flocculosa and Fragilaria crotonensis appeared to be favored by the inshore environment. Tabellaria flocculosa was present at all stations on almost all sampling dates with lowest numbers in the spring, except at Station 5, which in 1970 had a pring peak (Figure A-14). It was most abundant at the inshore stations with highest maximum and mean values at the station closest to Milwaukee (Table B-1). Fragilaria crotonensis was almost always present at all stations with peaks of abundance generally in the summer and fall, and at the inshore stations also, in the winter and spring (Figure A-15). The mean cell numbers of this species were greater at the inshore stations (Table B-1), but the greatest population (463/ml) was recorded at Station 4 on 24 August, 1972.

Asterionella formosa was most abundant during periods of thermal stratification (Figure A-16). Highest numbers were found at Station 5 on 16 June, 1971 when cells reached 226/ml. Mean values were not significantly different among the stations. Tarapchak and Stoermer (1976) listed Asterionella formosa as having its apparent maximum abundance in water that is moderately enriched. It would appear that some factor other than enrichment was also important.

Cyclotella michiganiana Skvortzow was most abundant during summer or fall (Figure A-17), and reached maximum numbers in midlake, but the mean abundance values there and at Station 5 were the same (Table B-1).

Cyclotella ocellata Pant. is a dominant diatom in Lake Superior in the Apostle Island region (Holland and Beeton 1973), as well as in the open lake (Holland 1965). It was present at all stations most of the time. At Station 1, it was most abundant in November 1970 and July 1971; at all other stations it was most abundant during the summer of 1972 (Figure A-18). Mean values at all stations were approximately the same.

Cyclotella comta (Ehr.) Kütz., another diatom well represented in Lake Superior, was common in the late summer or fall (Figure A-19).

Fragilaria construens was most abundant at inshore stations; peak periods of abundance were of short duration variably in spring, early summer, and winter (Figure A-20).

Fragilaria sp. 1 (illustrated in Holland 1969) was generally absent or in low abundance at all stations; numbers were highest in spring or early summer.

Diatoma tenue var. elongatum Agardh and Fragilaria pinnata Ehr. were found only occasionally and in low numbers at the offshore stations. They were found in moderate numbers in the spring and summer at the inshore stations, and at Station 1 they were sometimes also moderately abundant in the winter and fall.

Stephanodiscus alpinus has become a major species in Lake Erie in recent years where it reaches highest numbers in winter and spring (Hohn 1969). It has been reported primarily as a winter form in Lake Ontario (Stoermer et al. 1975). It was characteristic of the winter plankton at all stations,

and was present at Station 1 most of the year (Figure A-21). At the other stations, it had a second period of moderate abundance during the warm weather. It reached its highest numbers (111/ml) on 16 June, 1971 at Station 3.

Synedra radians Kütz. was most abundant for short periods during spring or summer (Figure A-22). Patrick and Reimer (1966) comment that this species is often found in waters with fairly high conductivity. The specific conductance of the waters when Synedra radians was most abundant ranged from 262-278 µmhos/cm; at Station 5, the maximum value of this variable recorded at this station was 276/µmhos/cm.

Synedra ulna (Nitzsch) Ehr. was most abundant (50/ml) at Station 3 on 16 June, 1971. Modest numbers were found at all stations, primarily in the spring (Figure A-23).

The offshore stations of this study were similar to each other and differed from the inshore stations, and the inshore stations were also different from each other. The influence of nutrient input from the Milwaukee area, primarily through the Milwaukee River, is the major reason why Station 1, closest to Milwaukee, shows the most eutrophic characteristics on this transect. The Pere Marquette River, which empties into the lake at Ludington, is a much poorer source of nutrients. In addition, the prevailing wind across the lake is from the west; consequently there is greater cloud cover and a greater concentration of ice floes along the east shore, reducing solar radiation.

The moderate peaks of diatoms in February 1972 occurred when nutrients were plentiful and when the possible solar radiation was increasing. Highest winter numbers of total diatoms (960/ml) were reached at Station 1 on 22 February when Stephanodiscus minutus was dominant at all stations (Figures A-4 and A-24). The number of diatoms from 12 January - 11 April, 1972 was 24% of the annual crop of diatoms at this station. Chandler and Weeks (1945) found a similar pulse, which was 94% diatoms, in western Lake Erie from 10 February - 12 April, 1942; it constituted 28.6% of the annual crop of phytoplankton, which was largely diatoms. The pulse began under ice cover when water temperature was 0.3°C and ended suddenly when ice cover disappeared. Its inception coincided with the seasonal increase in solar radiation. Chandler and Weeks attributed its abrupt termination to high turbidities due to wind action and river discharge. Brooks and Mortonson (1978) have found a maximum of chlorophyll a just under the thermocline, reaching peak concentrations in June (5 µg/l) and July (10 µg/l) at a deep water station east of Port Washington, Wisconsin. Brooks and Mortonson also showed that as nutrients decreased in the epilimnion, they remained the same or increased in the hypolimnion. It would appear then, that as long as nutrients are adequate, plankton flourishes in the cold water of the hypolimnion, and solar radiation is the limiting factor in plankton production. Essentially, the same conditions of temperature and nutrients exist throughout the water column of Lake Michigan during the winter as exist in the hypolimnion during the summer, so that winter productivity should depend largely upon what amount of solar radiation reaches the plank-

ton. In winter when there is less cloud cover over the lake, we should note increased productivity.

The data presented here from May 1970 - October 1972 further substantiate the preliminary finding (Holland and Beeton 1972) that there are differences in plankton and nutrients between inshore and offshore areas of the lake, and also between inshore areas themselves. These differences exist during all seasons and therefore should be considered a persistent feature of Lake Michigan limnology (see Figure A-4 for differences on one date in winter). The thermal bar (Rodgers 1965) may enhance these contrasts but Talling (1966) has shown differences in plankton and nutrients between inshore and offshore areas of Lake Victoria, a tropical lake that does not develop a thermal bar. The differences between inshore and offshore waters along the car ferry transect are primarily reflections of point sources of nutrients, the most striking of which is the Milwaukee area.

REFERENCES

Ahlstrom, E.H. 1936. The deep-water plankton of Lake Michigan, exclusive of the Crustacea. Trans. Am. Microsc. Soc. 55: 286-299.

Beeton, A.M. 1965. Eutrophication of the St. Lawrence Great Lakes. Limnol. Oceanogr. 10: 240-254.

Beeton, A.M. 1969. Changes in the environment and biota of the Great Lake. In: Eutrophication: Causes, Consequences, Correctives. Nat. Acad. Sci. Publ. 1700. pp. 150-187.

Beeton, A.M. and J.M. Barker. 1974. Investigation of the influence of thermal discharge from a large electric power station on the biology and near-shore circulation of Lake Michigan. Part A: Biology, Ctr. for Great Lakes Stds., Univ. Wisc., Milwaukee, Wisc. Spec. Rept. No. 18. 138 pp.

Beeton, A.M. and W.T. Edmondson. 1972. The eutrophication problem. J. Fish. Res. Board Can. 29: 673-682.

Brooks, A.S. and J.A. Mortonson. 1978. Vertical and seasonal distribution of chlorophyll a and nutrients in Lake Michigan. Verh. Internat. Verein. Limnol. 20: 334-335.

Chandler, D.C. and O.B. Weeks. 1945. Limnological studies of western Lake Erie. Part V. Relation of limnological and meteorological conditions to the production of phytoplankton in 1942. Ecolog. Monogr. 15: 435-456.

Claflin, L.W. 1975. A multivariate data analysis of Lake Michigan phytoplankton. Unpub. Ph.D. Thesis, Univ. Wisc., Madison, Wisc. 436 pp.

Davis, C.C. 1964. Evidence for the eutrophication of Lake Erie from phytoplankton records. Limnol. Oceanogr. 9: 275-283.

Davis, C.C. 1966. Plankton studies in the largest Great Lakes of the world with special reference to the St. Lawrence Great Lakes of North America. Univ. Mich., Great Lakes Res. Div., Ann Arbor, Mich. Publ. 14. pp. 1-36.

Federal Water Pollution Control Administration. 1968a. Lake Michigan Basin: physical and chemical quality conditions. GPO. 81 pp.

Federal Water Pollution Control Administration. 1968b. Lake Michigan Basin: biology. GPO. 41 pp.

Fee, E.J. 1971. A numerical model for the estimation of integral primary production and its application to Lake Michigan. Unpub. Ph.D. Thesis, Univ. Wisc., Madison, Wisc. 168 pp.

Hohn, M.H. 1969. Qualitative and quantitative analyses of plankton diatoms, Bass Island area, Lake Erie, 1938-1965. Bull. Ohio. Biol. Surv. N.S. 3: 1-211.

Holland, R.E. 1965. The distribution and abundance of planktonic diatoms in Lake Superior. Univ. Mich., Great Lakes Res. Div., Ann Arbor, Mich. Publ. 13. pp. 96-105.

Holland, R.E. 1968. Correlation of Melosira species with trophic conditions in Lake Michigan. Limnol. Oceanogr. 13: 555-557.

Holland, R.E. 1969. Seasonal fluctuations of Lake Michigan diatoms. Limnol. Oceanogr. 14: 423-436.

Holland, R.E. and A.M. Beeton. 1972. Significance to eutrophication of spatial differences in nutrients and diatoms in Lake Michigan. Limnol. Oceanogr. 17: 88-96.

Holland, R.E. and A.M. Beeton. 1973. Planktonic diatoms in western Lake Superior, summer and fall 1972. Report prepared for litigation, U.S. Gov. vs. Reserve Mining Co., at the request of the Wisc. Attorney General's Office and the U.S. Legal Support Division.

Holland and L.W. Claflin. 1975. Horizontal distribution of planktonic diatoms in Green Bay, mid-July 1970. Limnol. Oceanogr. 20: 365-378.

Huber-Pestalozzi, G. 1942. Die Binnengewasser Band 16, Das Phytoplankton des Susswassers, Teil 2, Halfte 2, Diatomeen. Stuttgart, E. Schweizerbart'sche Verlagsbuchhandlung. pp. 367-549.

Kilham, S.S. and P. Kilham. 1978. Natural community bioassays: predictions of results based on nutrient physiology and competition. Verh. Internat. Verein. Limnol. 20: 68-74.

Lund, J.W.G. 1954. The seasonal cycle of the plankton diatom, Melosira italica (Ehr.) Kütz. subsp. subarctica O. Müll. J. Ecol. 42: 141-179.

Mortimer, C.H. 1975. Environmental status of the Lake Michigan region. Vol. 2. Physical limnology of Lake Michigan. Part 1. Physical characteristics of Lake Michigan and its responses to applied forces. Argonne National Lab. pp. 13-102.

Munawar, M.M. and A. Nauwerck. 1971. The composition and horizontal distribution of phytoplankton in Lake Ontario during the year 1970. Proc. 14th Conf. Geat Lakes Res., Internat. Assoc. Great Lakes Res. pp. 69-78.

Patrick R. and C.W. Reimer. 1966. The diatoms of the United States exclusive of Alaska and Hawaii. Vol. 1. Acad. of Natural Sciences of Philadelphia. Monograph 13. 688 pp.

Rodgers, G.K. 1965. The thermal bar in the Laurentian Great Lakes. Univ. Mich., Great Lakes Res. Div., Ann Arbor, Mich. Publ. 13. pp. 358-363.

Rousar, D.C. 1973. Seasonal and spatial changes in primary production and nutrients in Lake Michigan. Water, Air, and Soil Pollution. 2: 497-514.

Stoermer, E.F. and J.J. Yang. 1969. Plankton diatom assemblages in Lake Michigan. Univ. Mich., Great Lakes Res. Div., Ann Arbor, Mich. Spec. Rept. No. 47. 268 pp.

Stoermer, E.F., M.M. Bowman, J.C. Kingston, and A.L. Shaedel. 1975. Phytoplankton composition and abundance in Lake Ontario during IFYGL. EPA-660/3-75-004, U.S. Environmental Protection Agency, Corvallis, Oregon. 373 pp.

Talling, J.F. 1966. The annual cycle of stratification and phytoplankton growth in Lake Victoria (East Africa). Int. Rev. Gesamten Hydrobiol. 51: 545-621.

Tarapchak, S.J. and E.F. Stoermer. 1976. Environmental status of the Lake Michigan region. Vol. 4. Phytoplankton of Lake Michigan. Argonne National Lab. 177 pp.

Tilman, D. 1977. Resource competition between planktonic algae: an experimental and theoretical approach. Ecology. 58: 338-348.

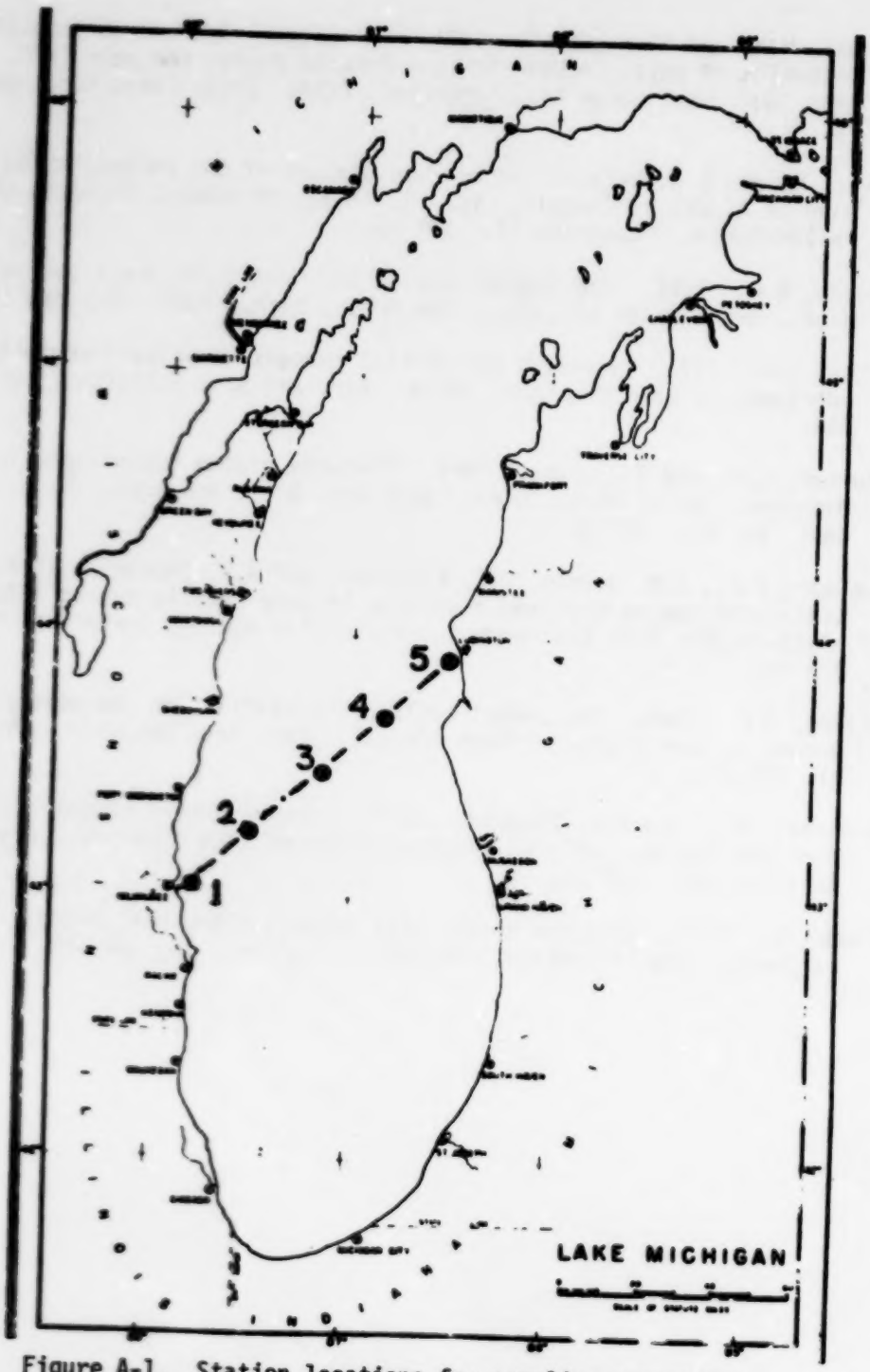

Figure A-1. Station locations for sampling across Lake Michigan from the S.S. Badger, May 1970 - October 1972.

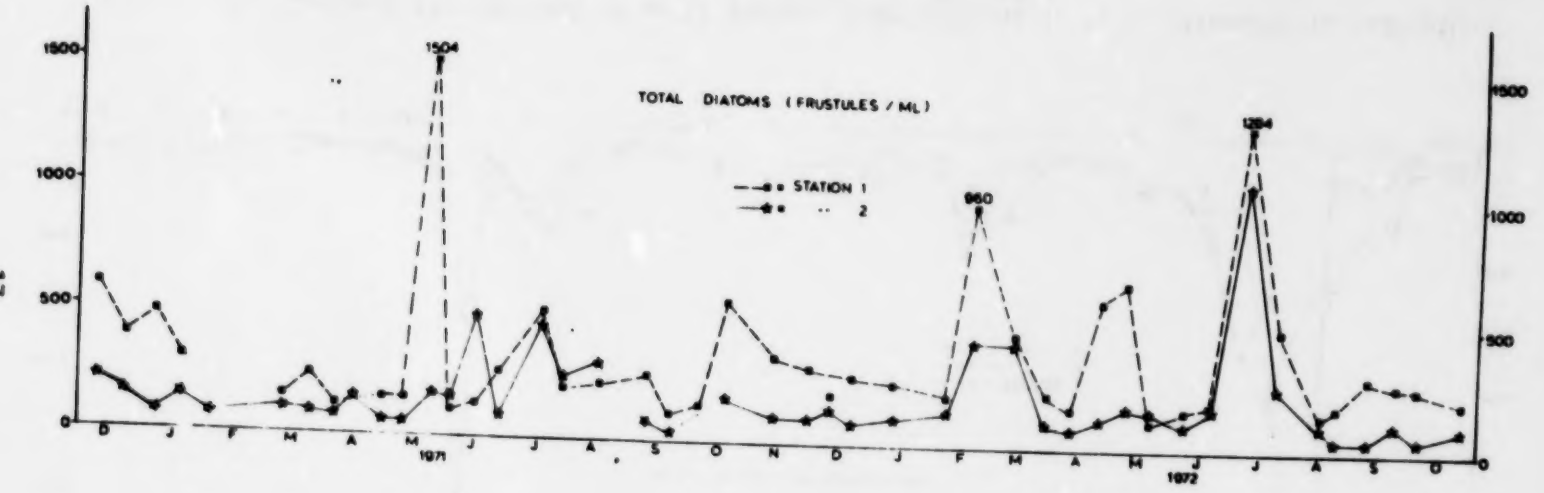

Figure A-2. Seasonal fluctuations of total diatoms from Stations 1 and 2, Milwaukee to Ludington transect, December 1970 - October 1972.

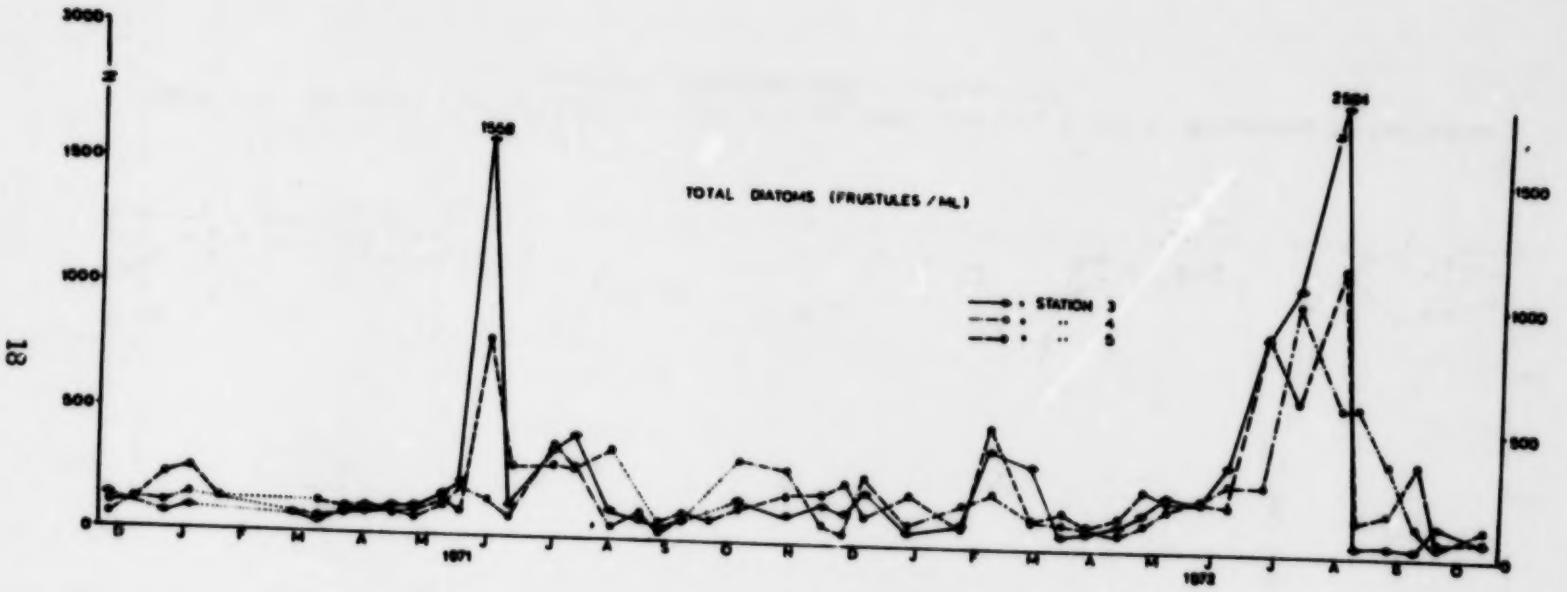

Figure A-3. Seasonal fluctuations of total diatoms from Stations 3, 4, 5, Milwaukee to Ludington transect, December 1970 - October 1972.

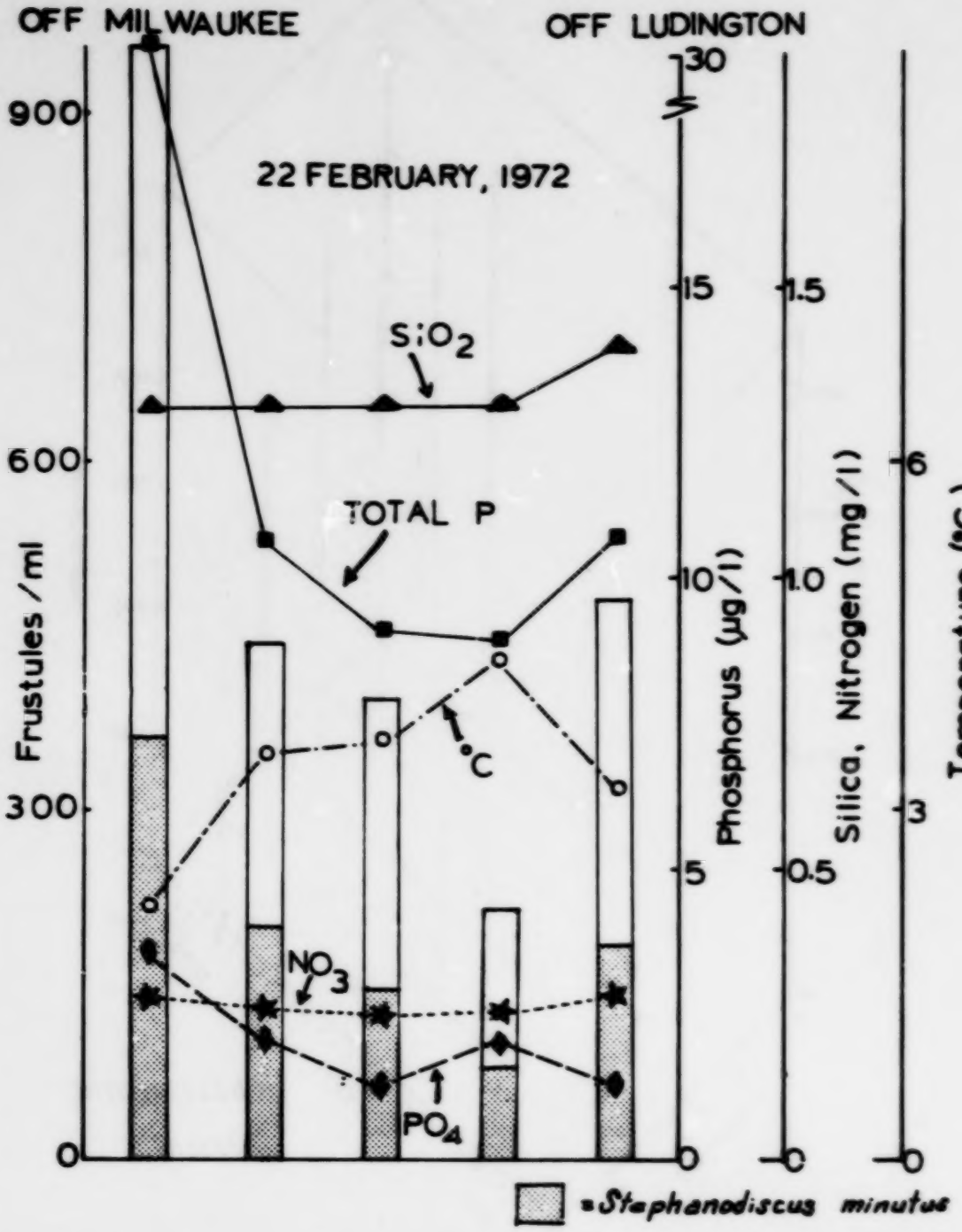

Figure A-4. Abundance of diatoms and associated corollary data for five stations across Lake Michigan, Milwaukee to Ludington, 22 February 1972.

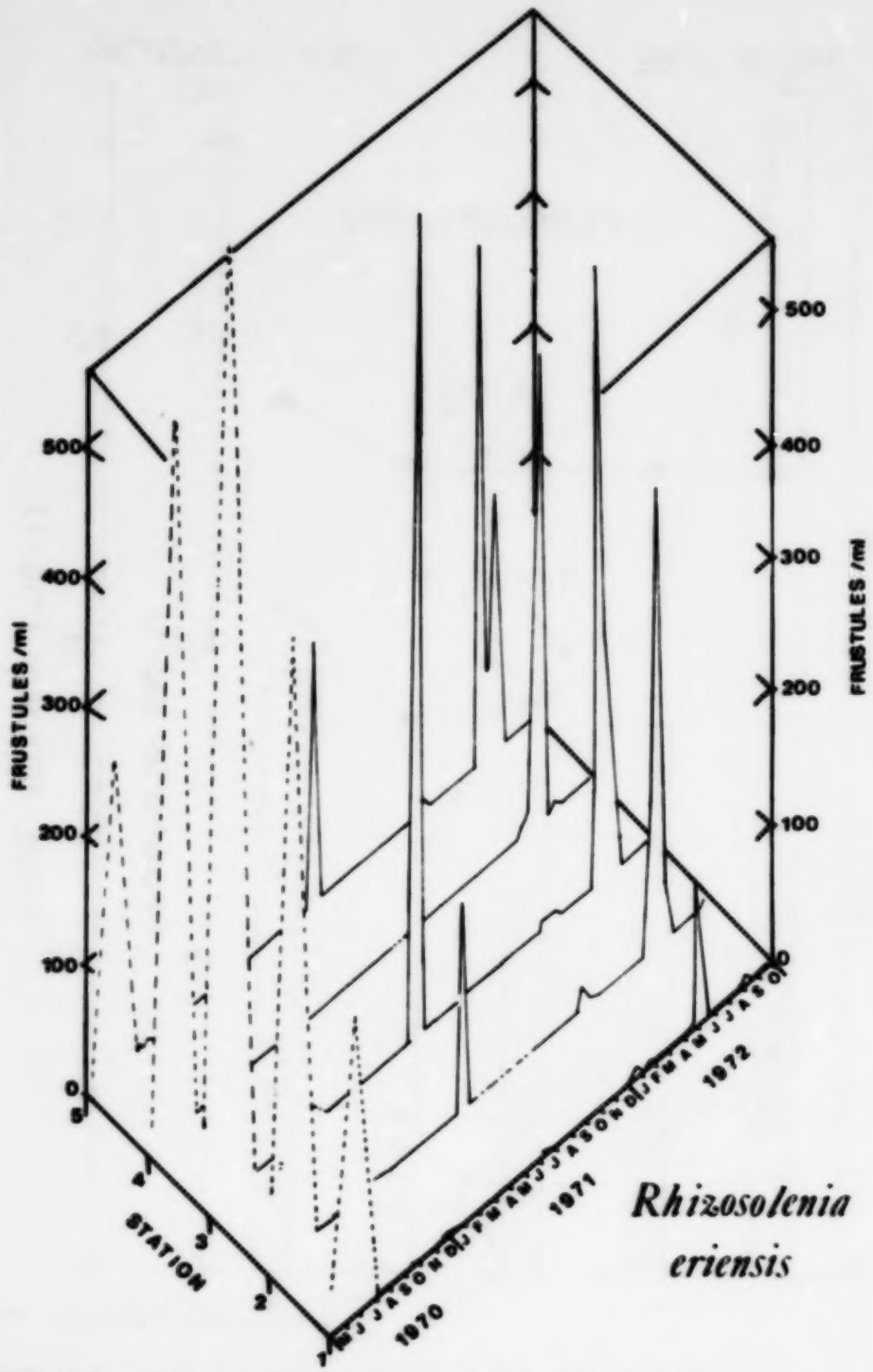

Figure A-5. Seasonal fluctuations of Rhizosolenia eriensis at five stations across Lake Michigan, May 1970- October 1972. (Broken lines between points indicate missing data.)

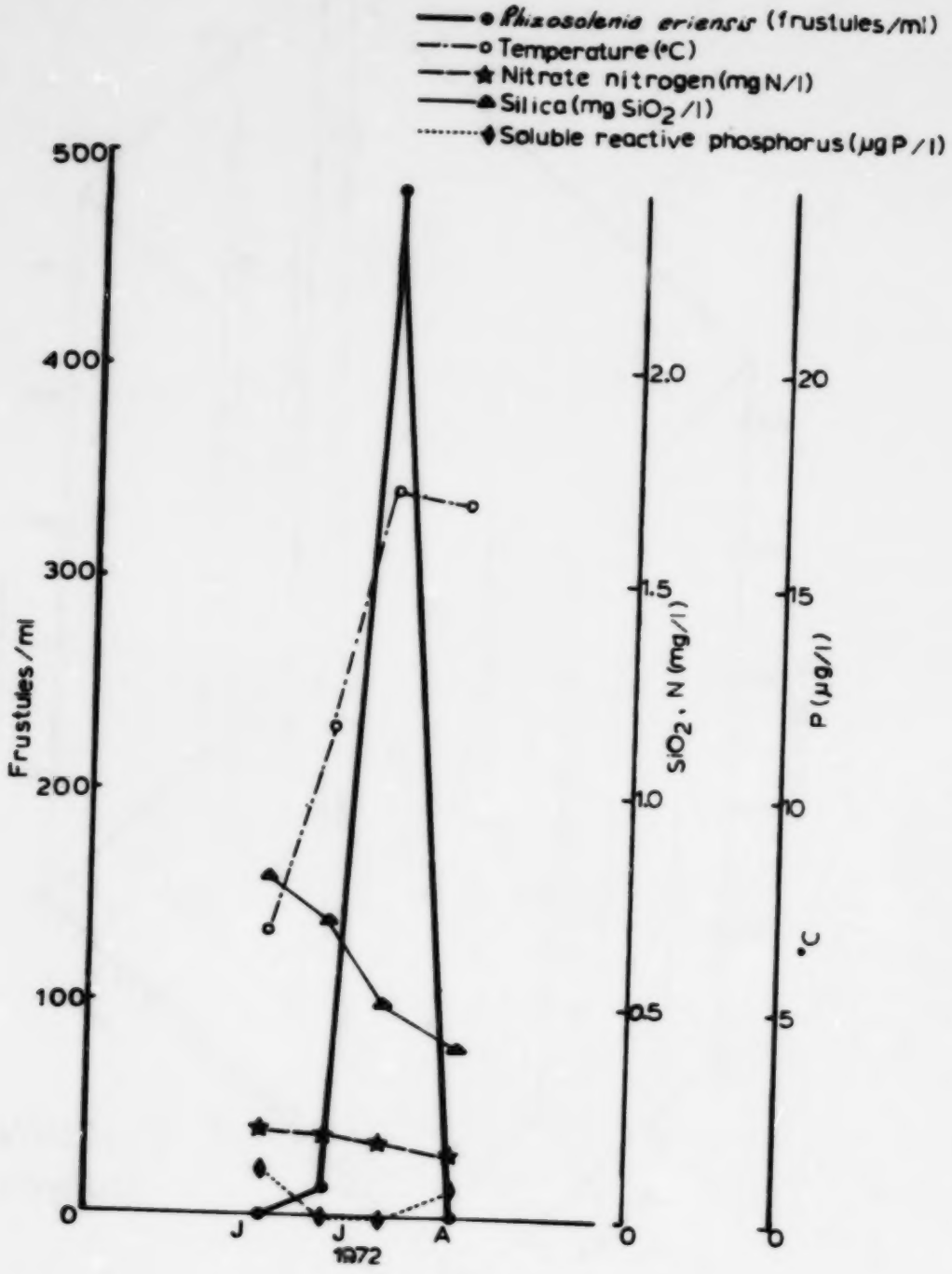

Figure A-6. Abundance of Rhizosolenia eriensis in exponential growth phase and associated variables at Station 4, summer 1972.

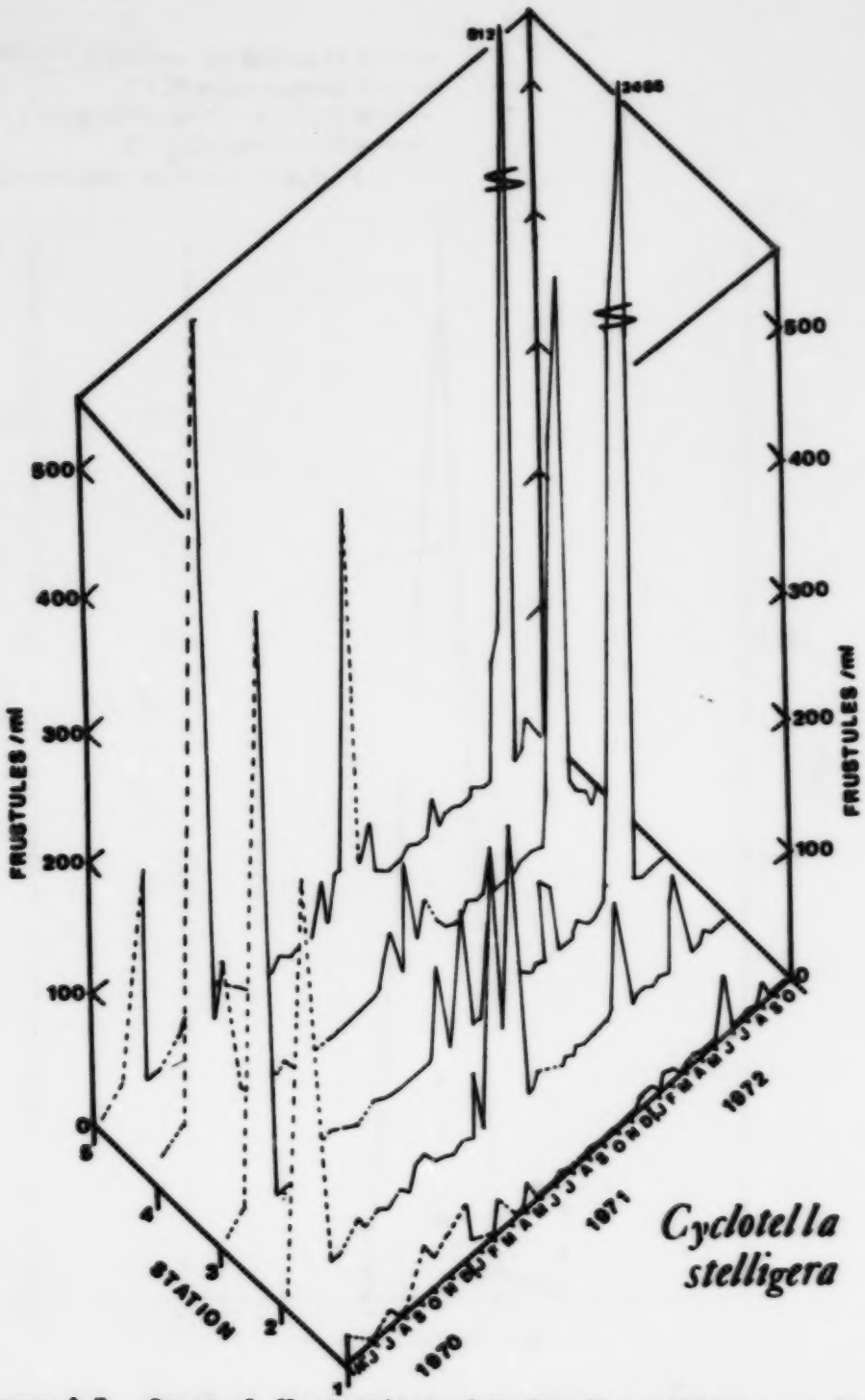

Figure A-7. Seasonal fluctuations of Cyclotella stelligera at five stations across Lake Michigan, May 1970 - October 1972. (Broken lines between points indicate missing data.)

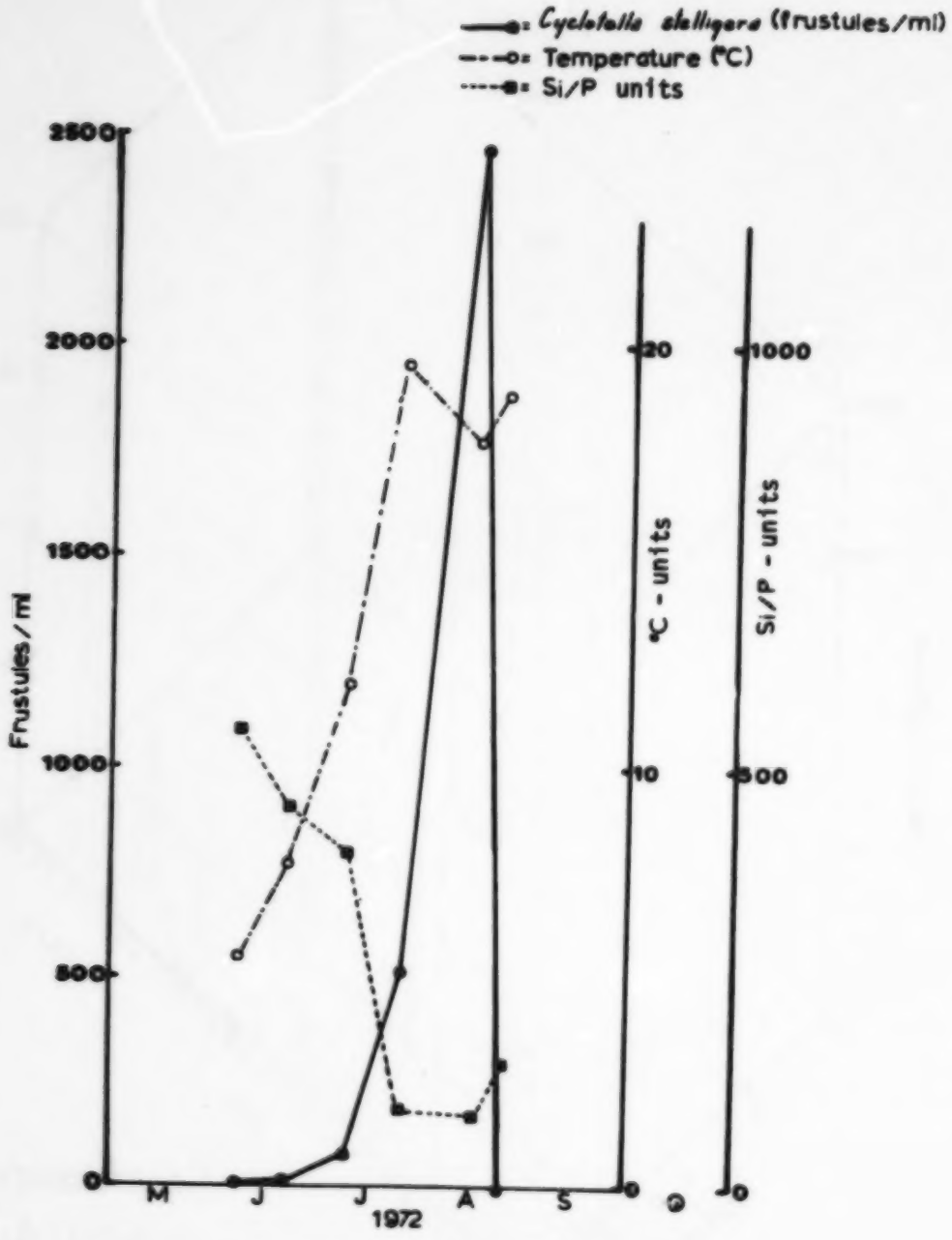

Figure A-8. Abundance of Cyclotella stelligera in exponential growth phase and associated variables at Station 3, summer 1972.

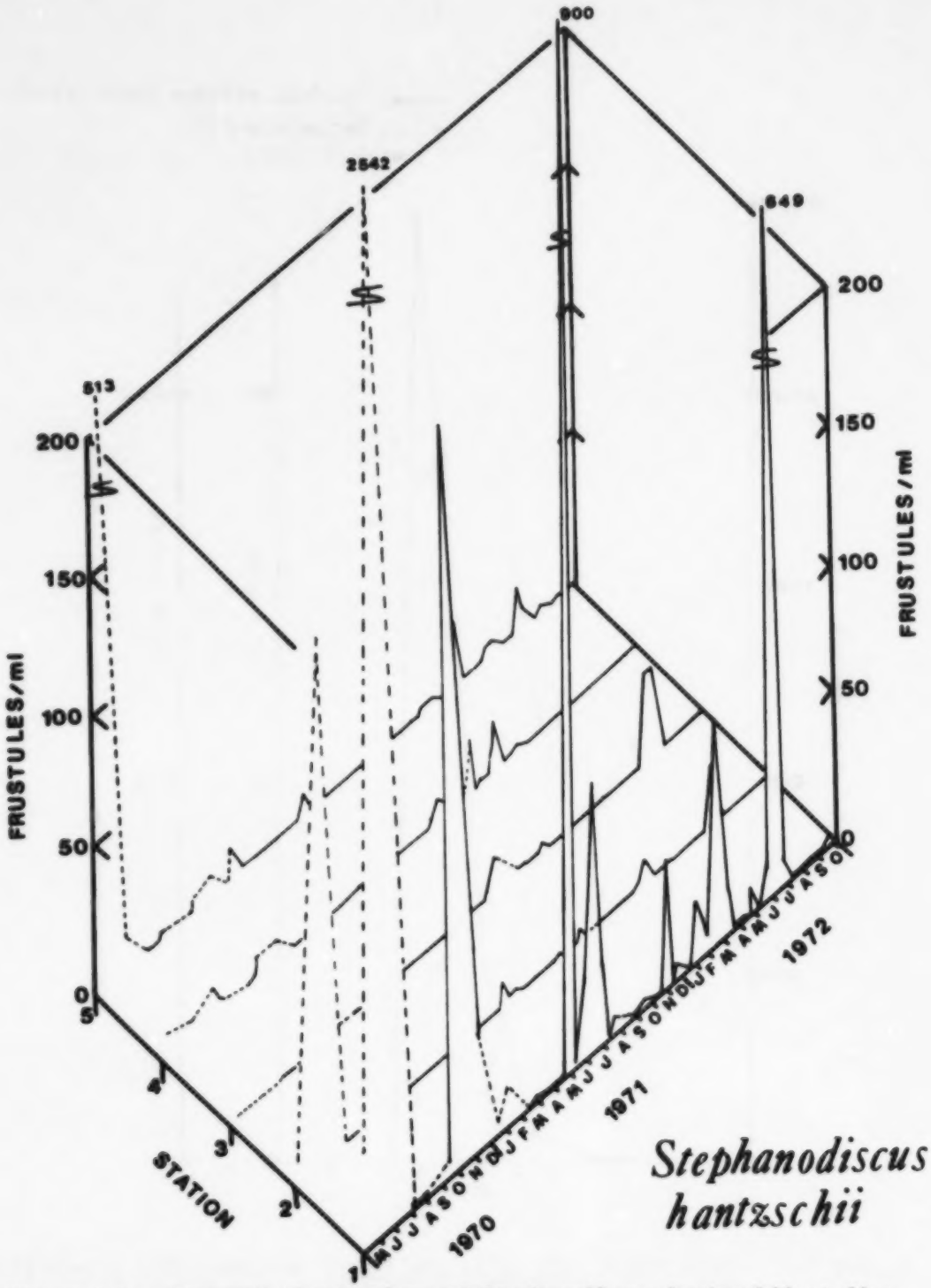

Figure A-9. Seasonal fluctuations of Stephanodiscus hantzschii at five stations across Lake Michigan, May 1970 - October 1972. (Broken lines between points indicate missing data.)

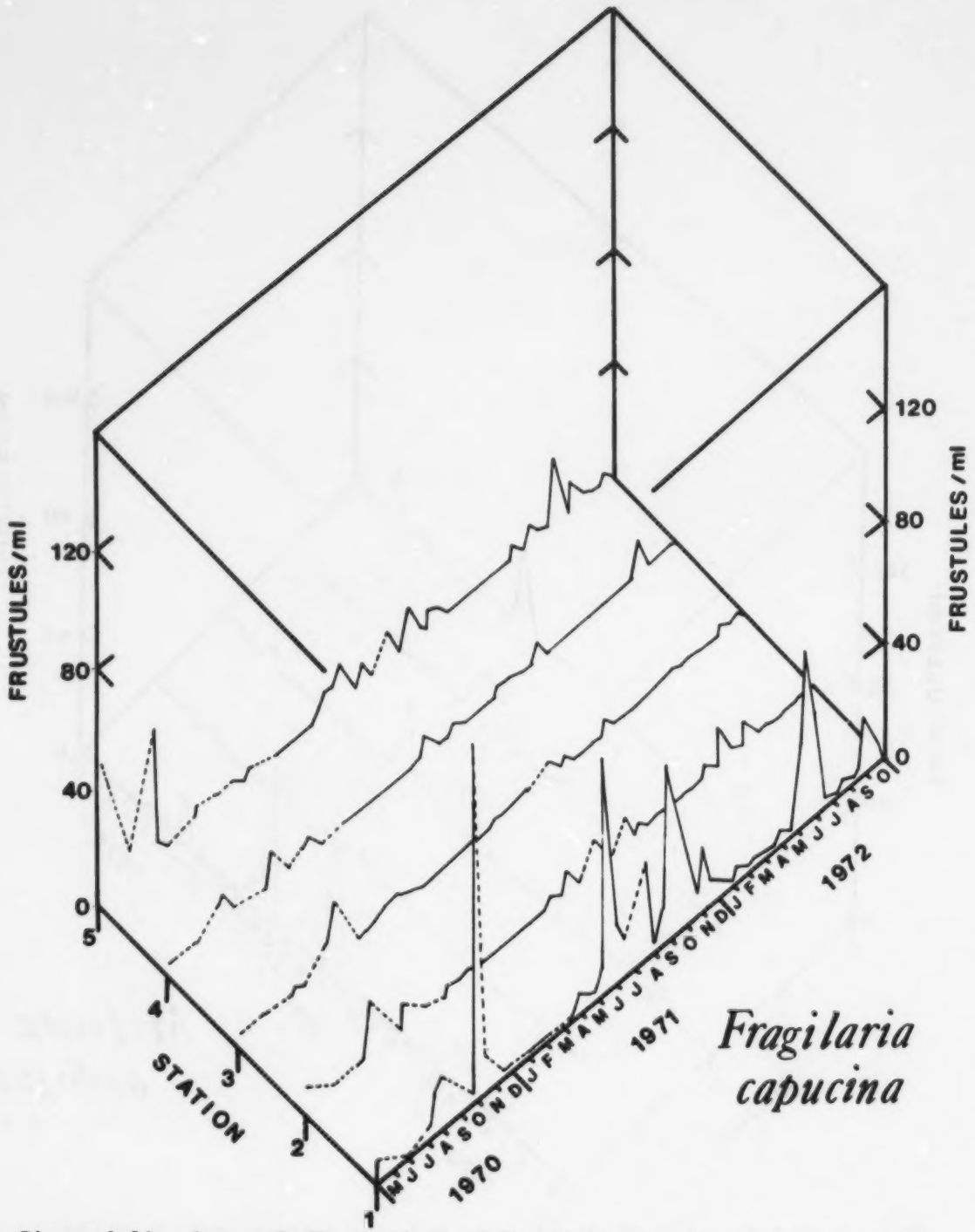

Figure A-10. Seasonal fluctuations of Fragilari capucina at five stations across Lake Michigan, May 1970 - October 1972. (Broken lines between points indicate missing data.)

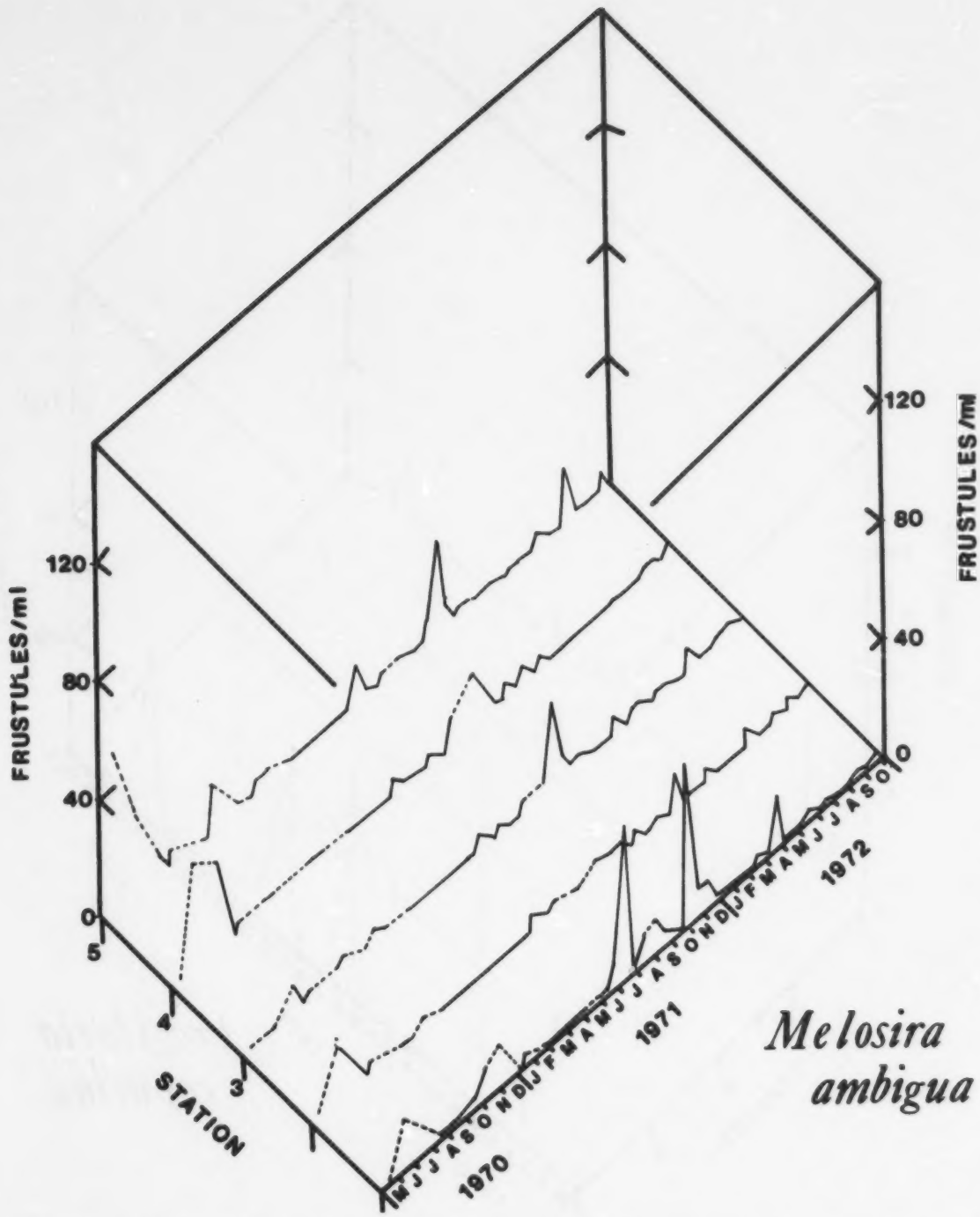

Figure A-11. Seasonal fluctuations of Melosira ambigua at five stations across Lake Michigan, May 1970 - October 1972. (Broken lines between points indicate missing data.)

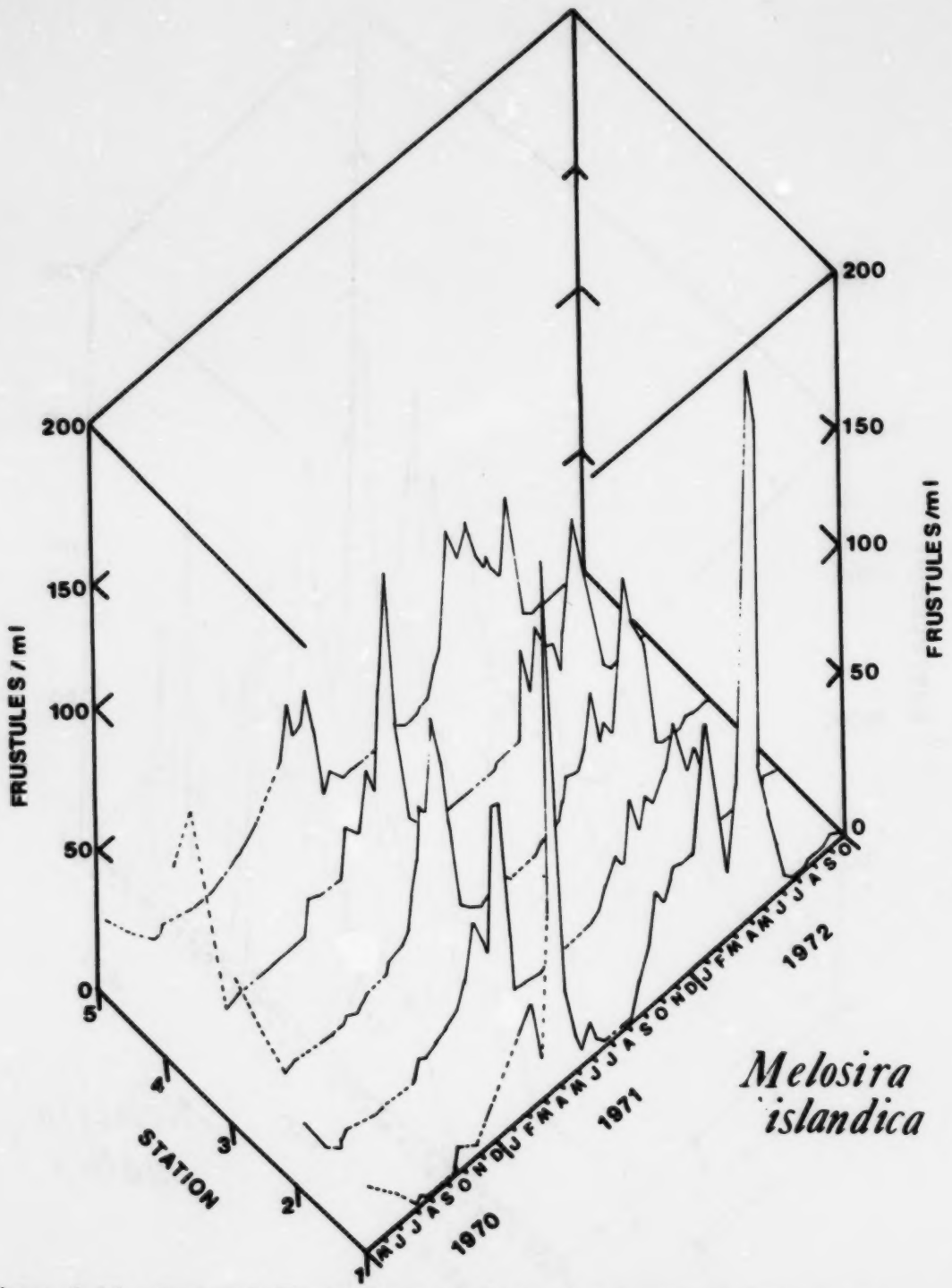

Figure A-12. Seasonal fluctuations of Melosira islandica at five stations across Lake Michigan, May 1970 - October 1972.
(Broken lines between points indicate missing data.)

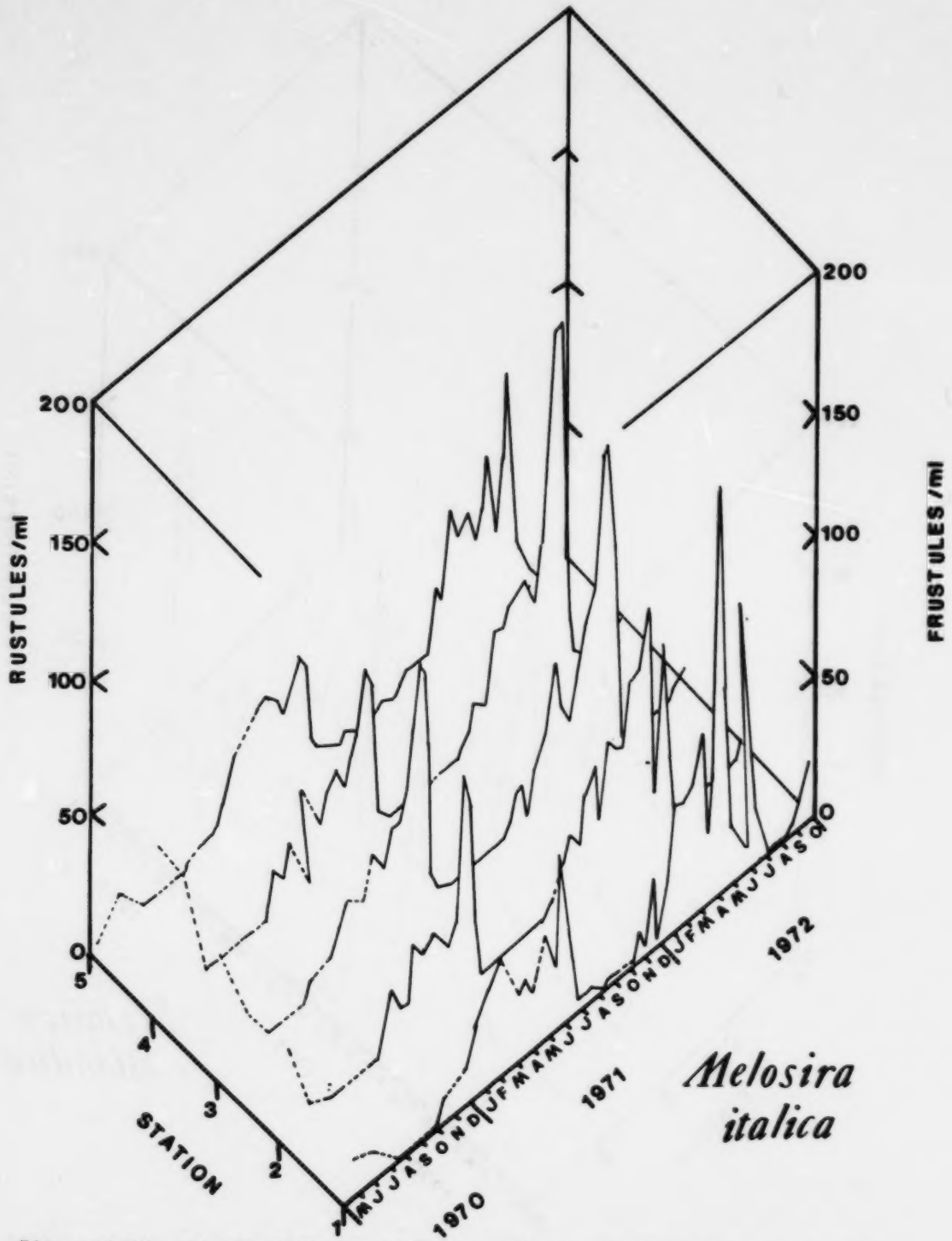

Figure A-13. Seasonal fluctuations of Melosira italica at five stations across Lake Michigan, May 1970 - October 1972.
(Broken lines between points indicate missing data.)

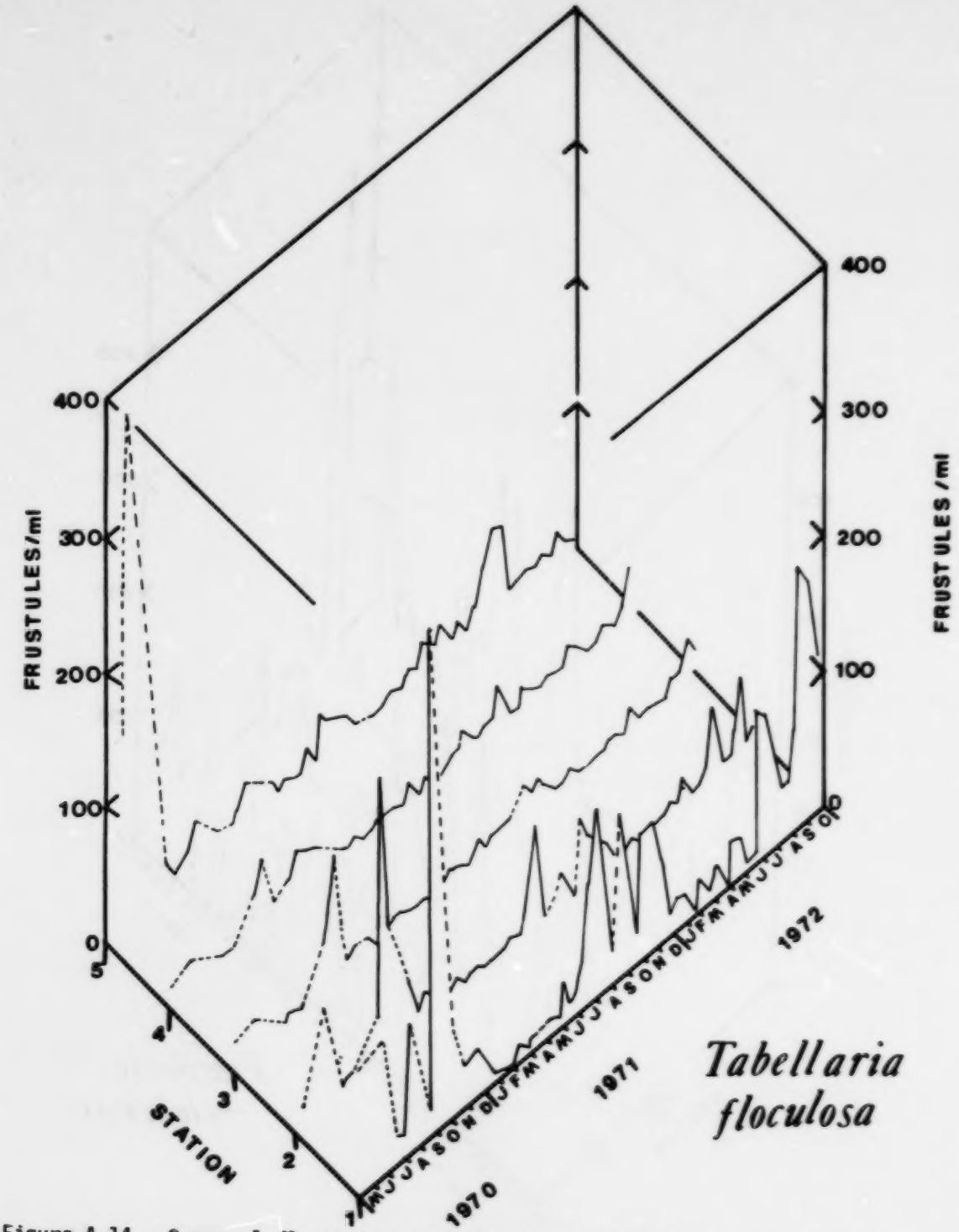

Figure A-14. Seasonal fluctuations of Tabellaria flocculosa at five stations across Lake Michigan, May 1970 - October 1972. (Broken lines between points indicate missing data.)

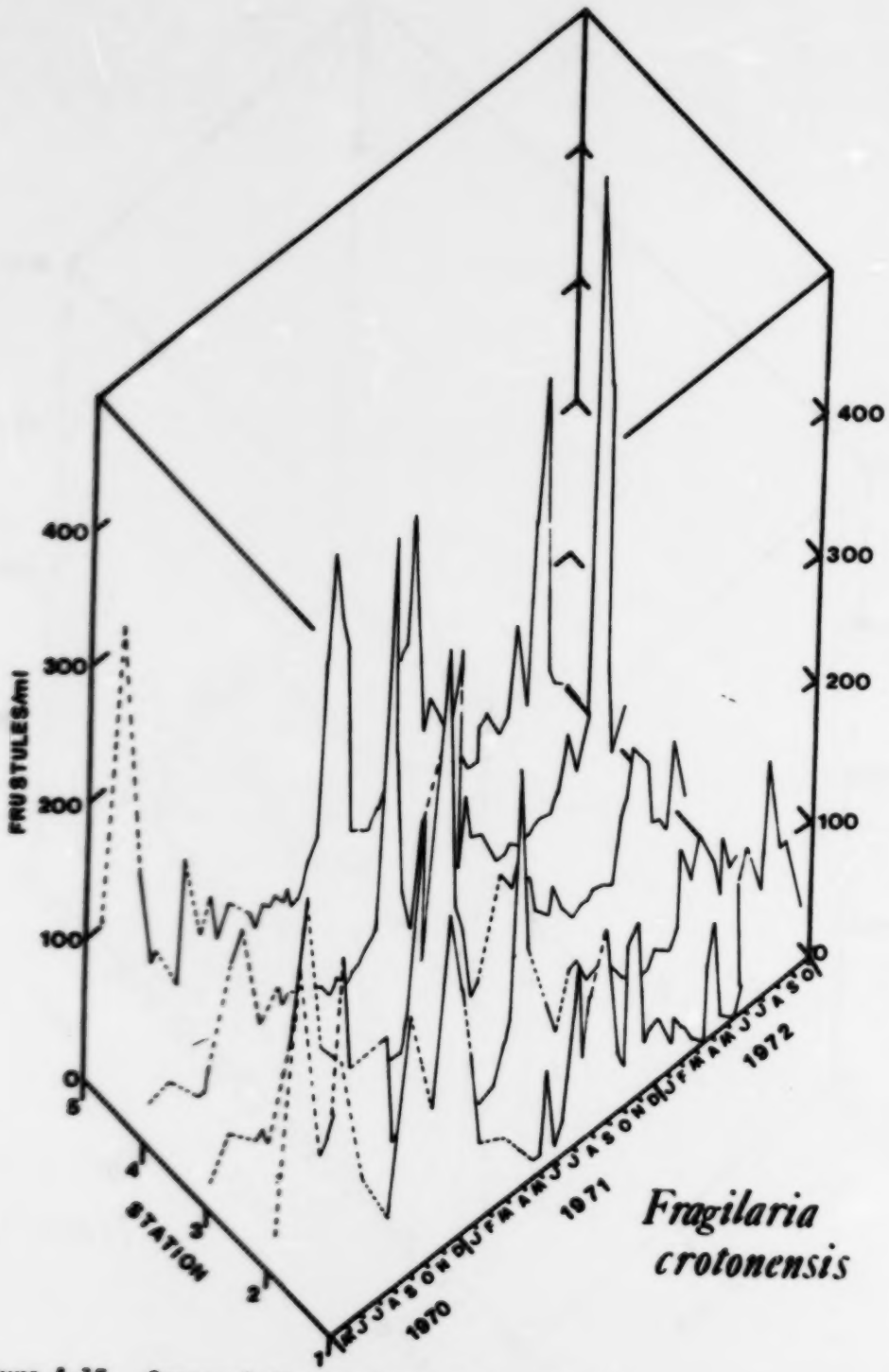

Figure A-15. Seasonal fluctuations of Fragilaria crotonensis at five stations across Lake Michigan, May 1970 - October 1972. (Broken lines between points indicate missing data.)

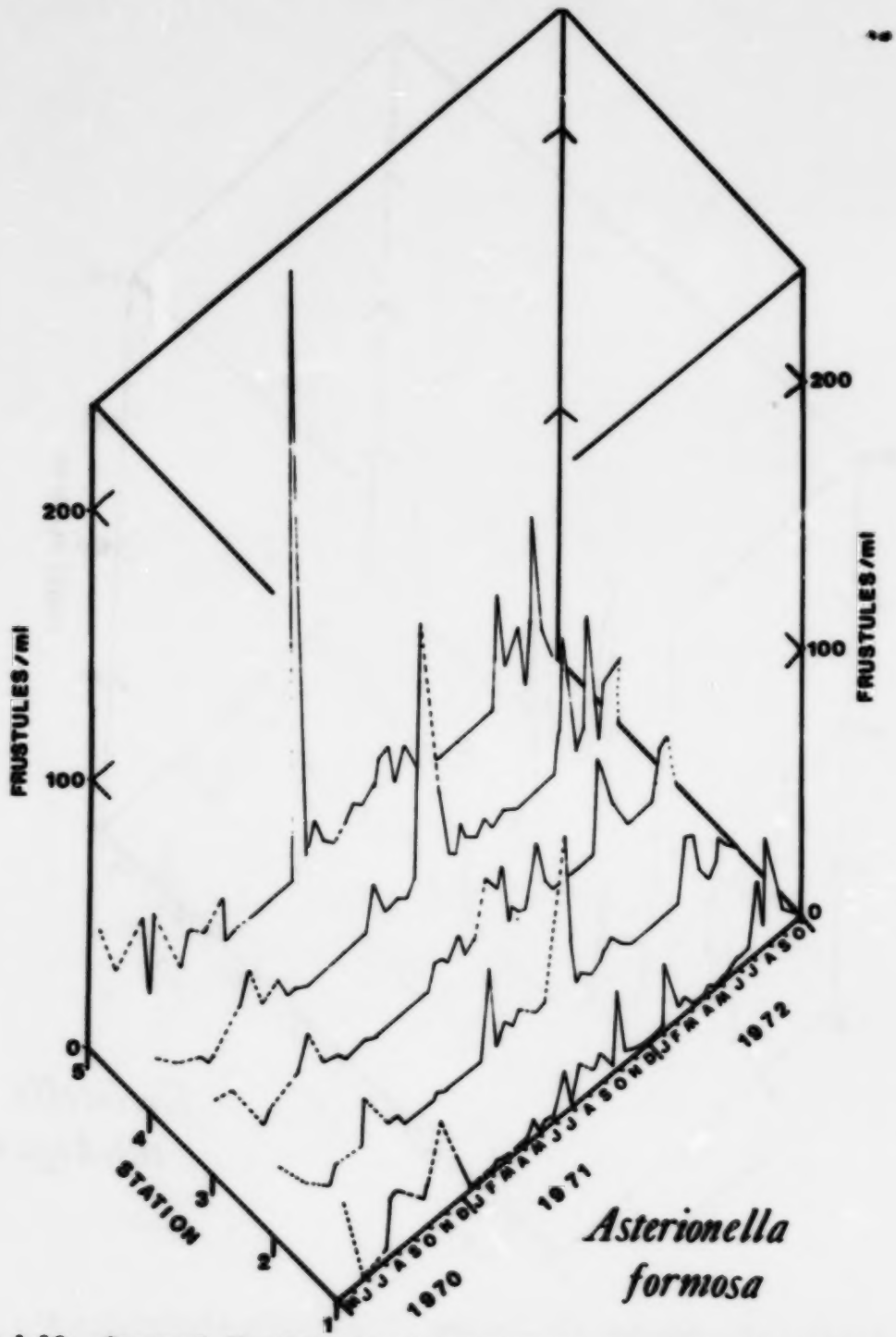

Figure A-16. Seasonal fluctuations of Asterionella formosa at five stations across Lake Michigan, May 1970 - October 1972. (Broken lines between points indicate missing data.)

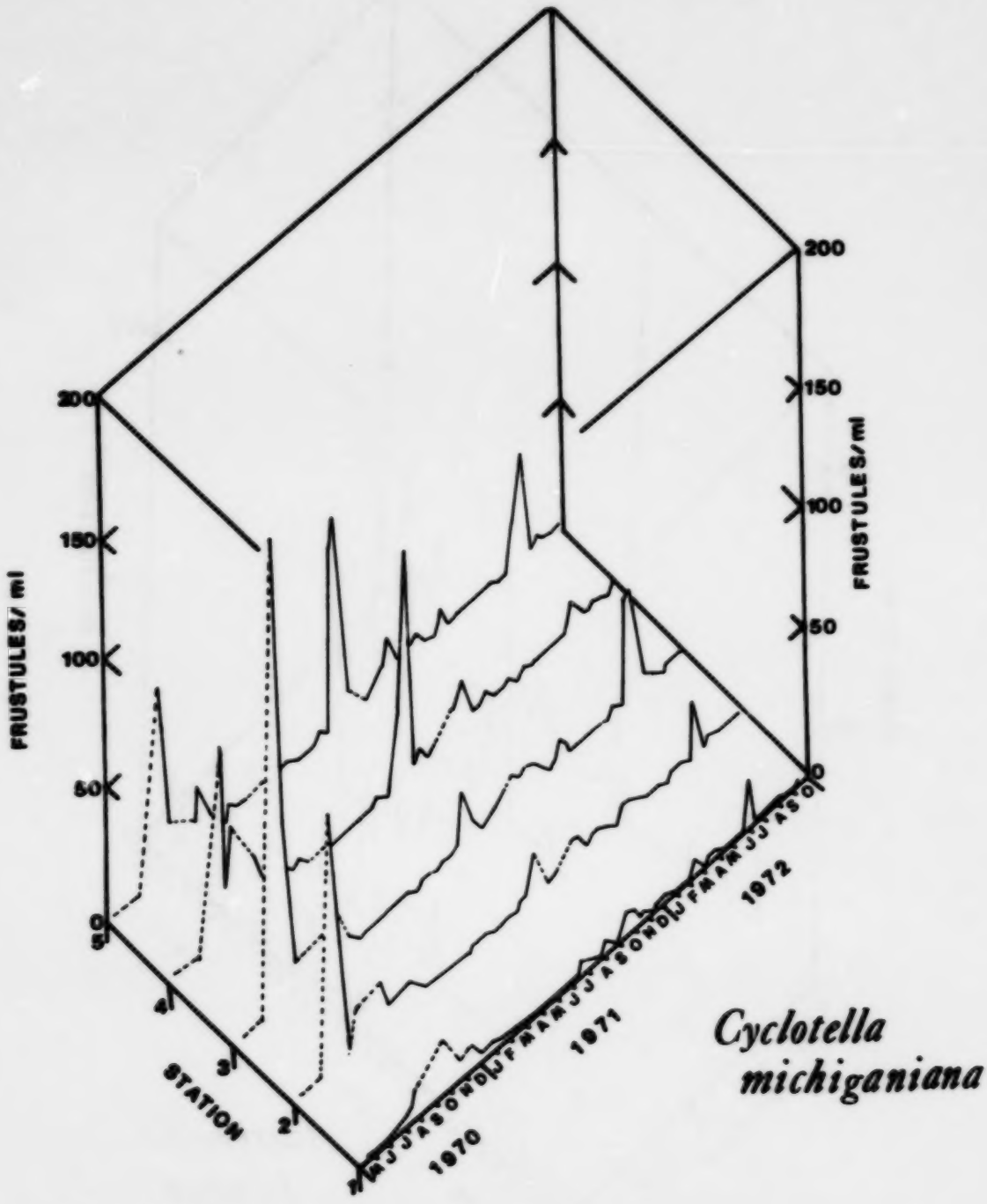

Figure A-17. Seasonal fluctuations of Cyclotella michiganiana at five stations across Lake Michigan, May 1970 - October 1972. (Broken lines between points indicate missing data.)

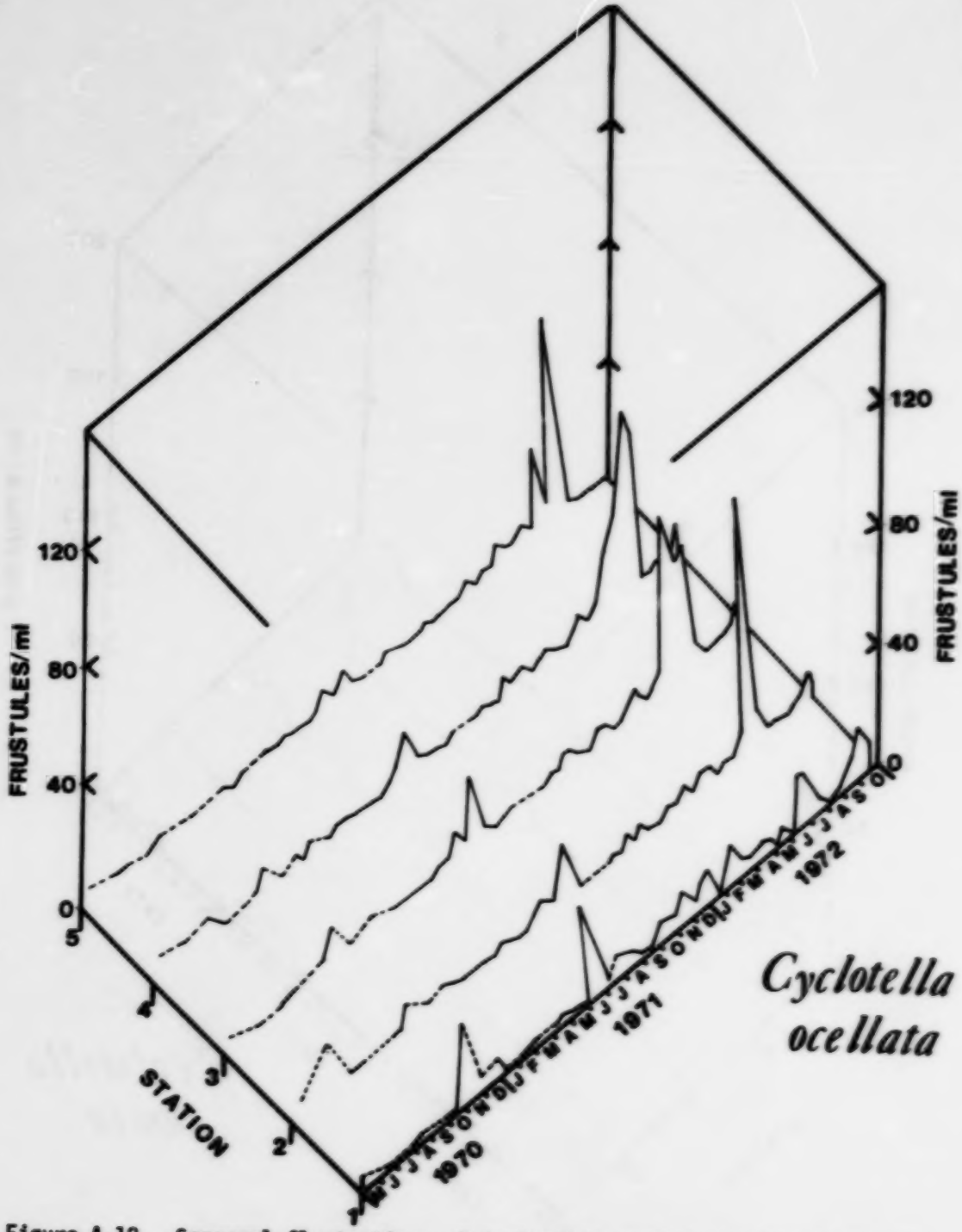

Figure A-18. Seasonal fluctuations of Cyclotella ocellata at five stations across Lake Michigan, May 1970 - October 1972. (Broken lines between points indicate missing data.)

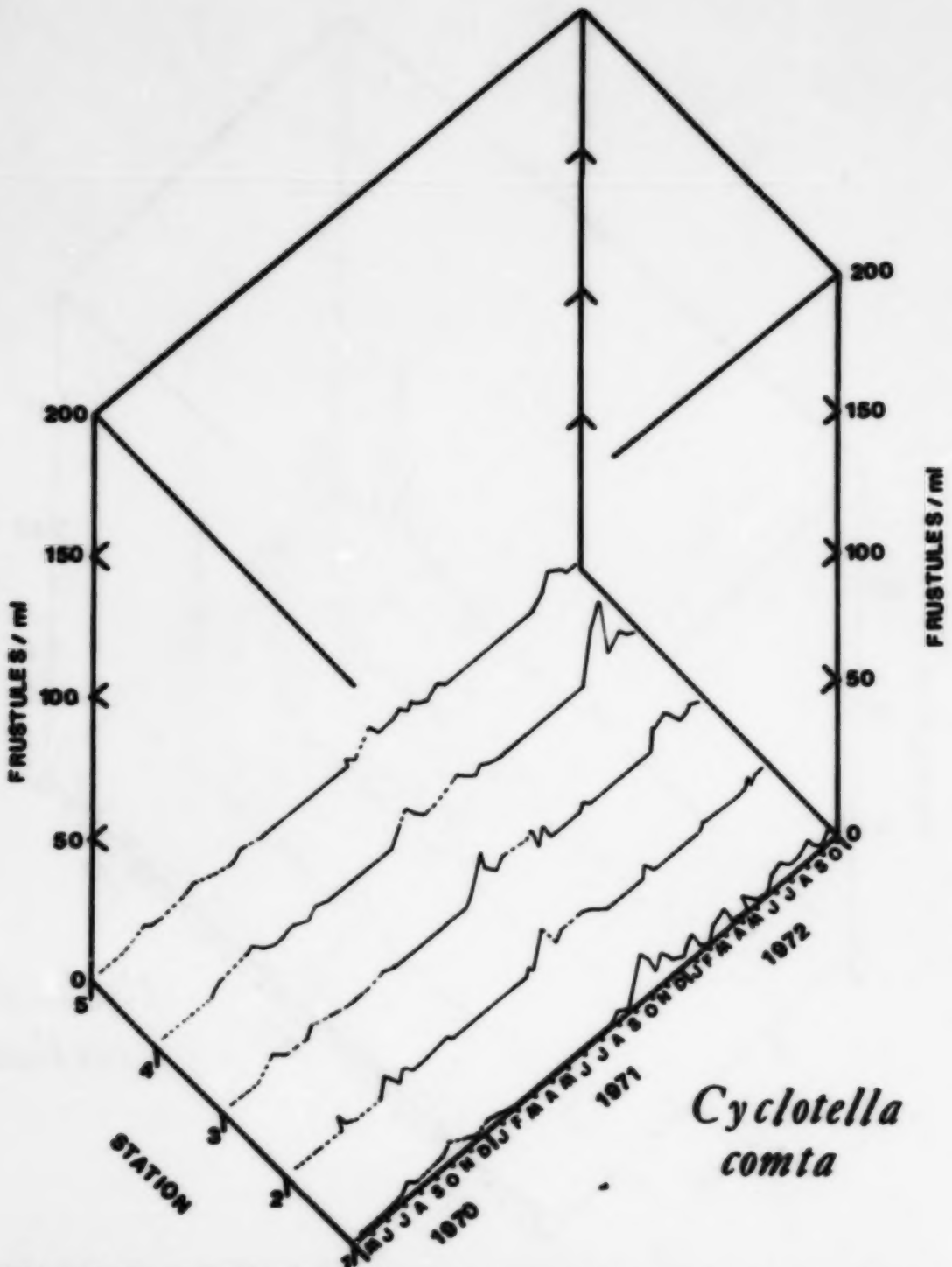

Figure A-19. Seasonal fluctuations of Cyclotella comta at five stations across Lake Michigan, May 1970 - October 1972.
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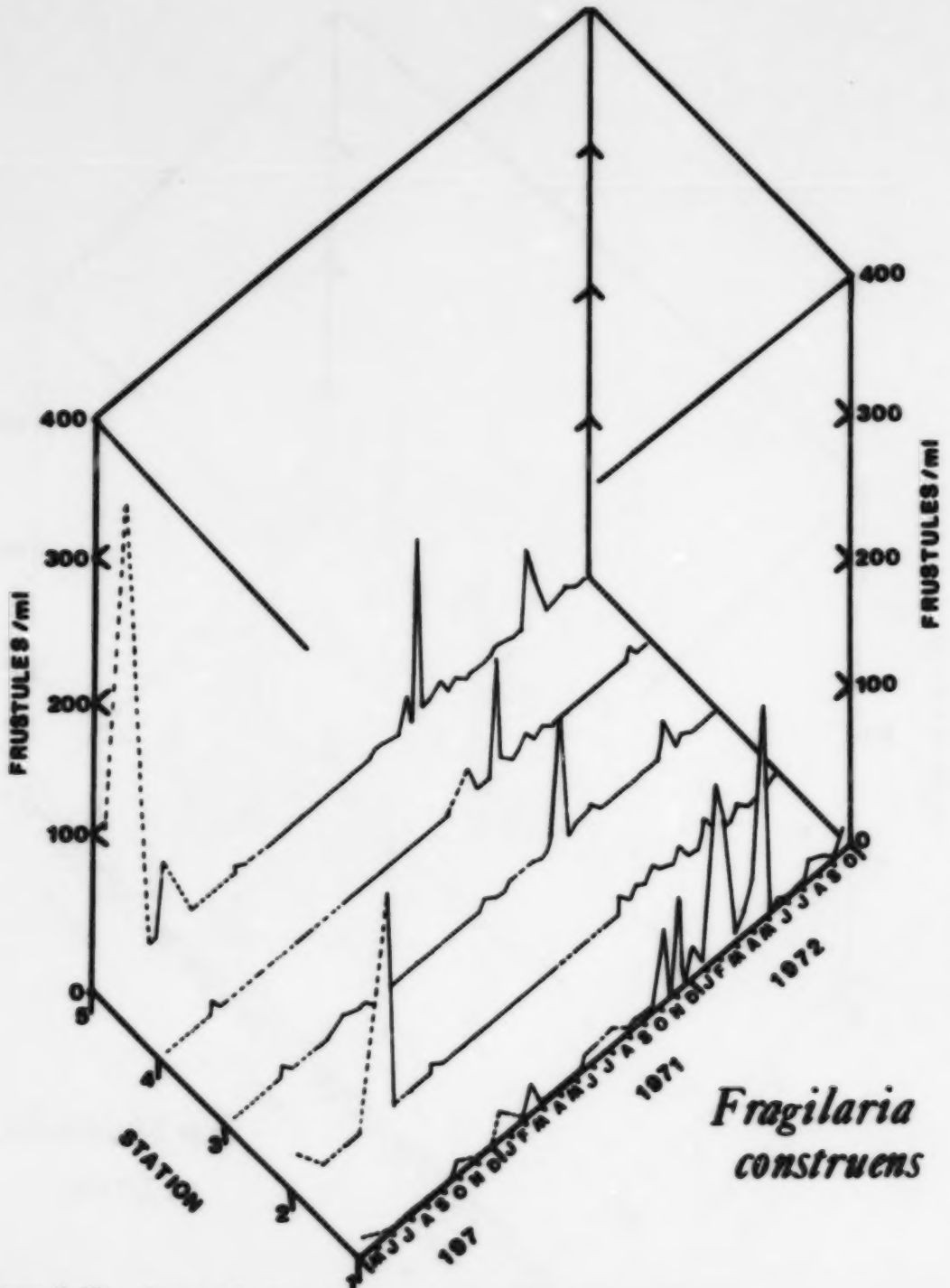

Figure A-20. Seasonal fluctuations of Fragilaria construens at five stations across Lake Michigan, May 1970 - October 1972.
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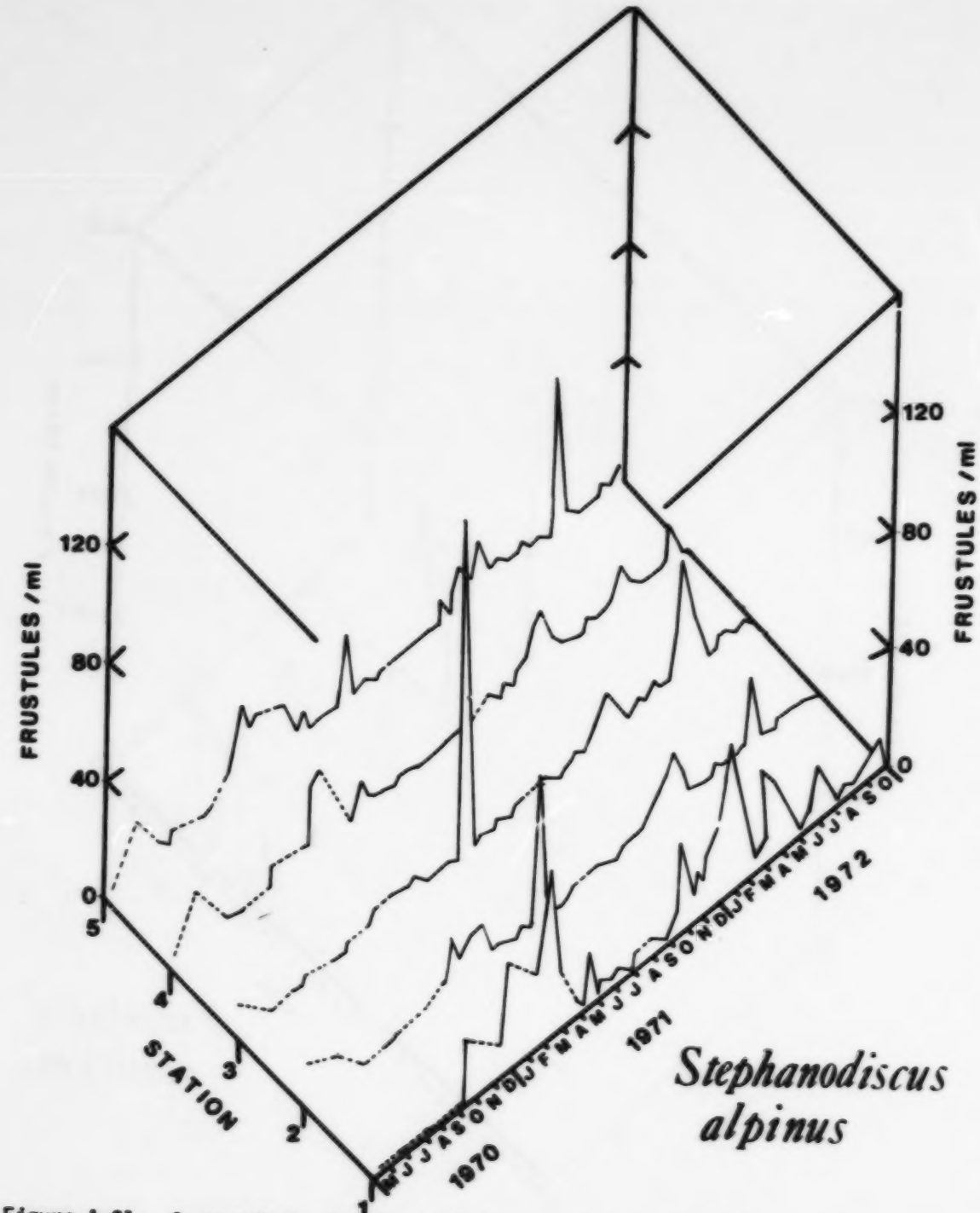

Figure A-21. Seasonal fluctuations of Stephanodiscus alpinus at five stations across Lake Michigan, May 1970 - October 1972. (Broken lines between points indicate missing data.)

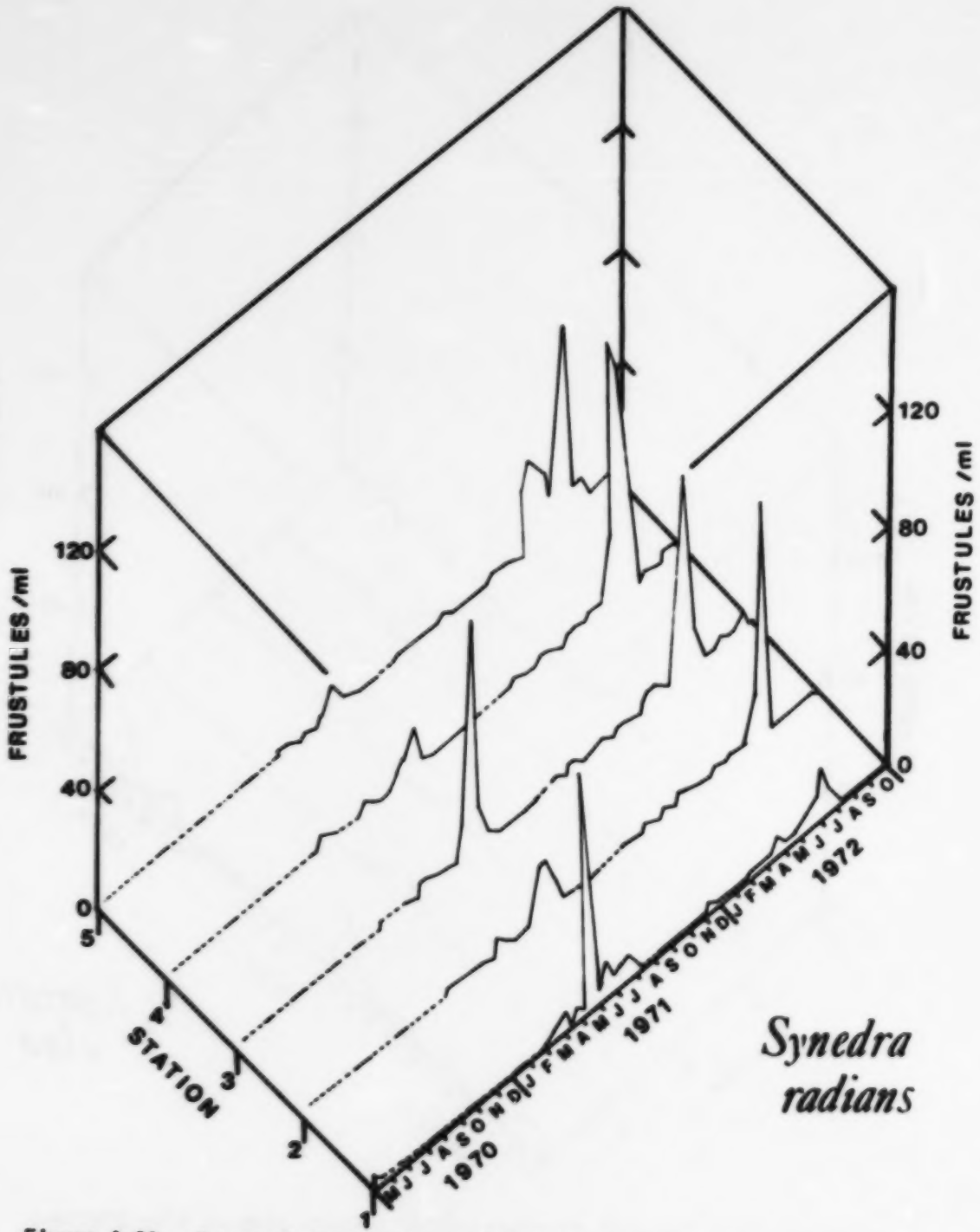

Figure A-22. Seasonal fluctuations of Synedra radians at five stations across Lake Michigan, May 1970 - October 1972. (Broken lines between points indicate missing data.)

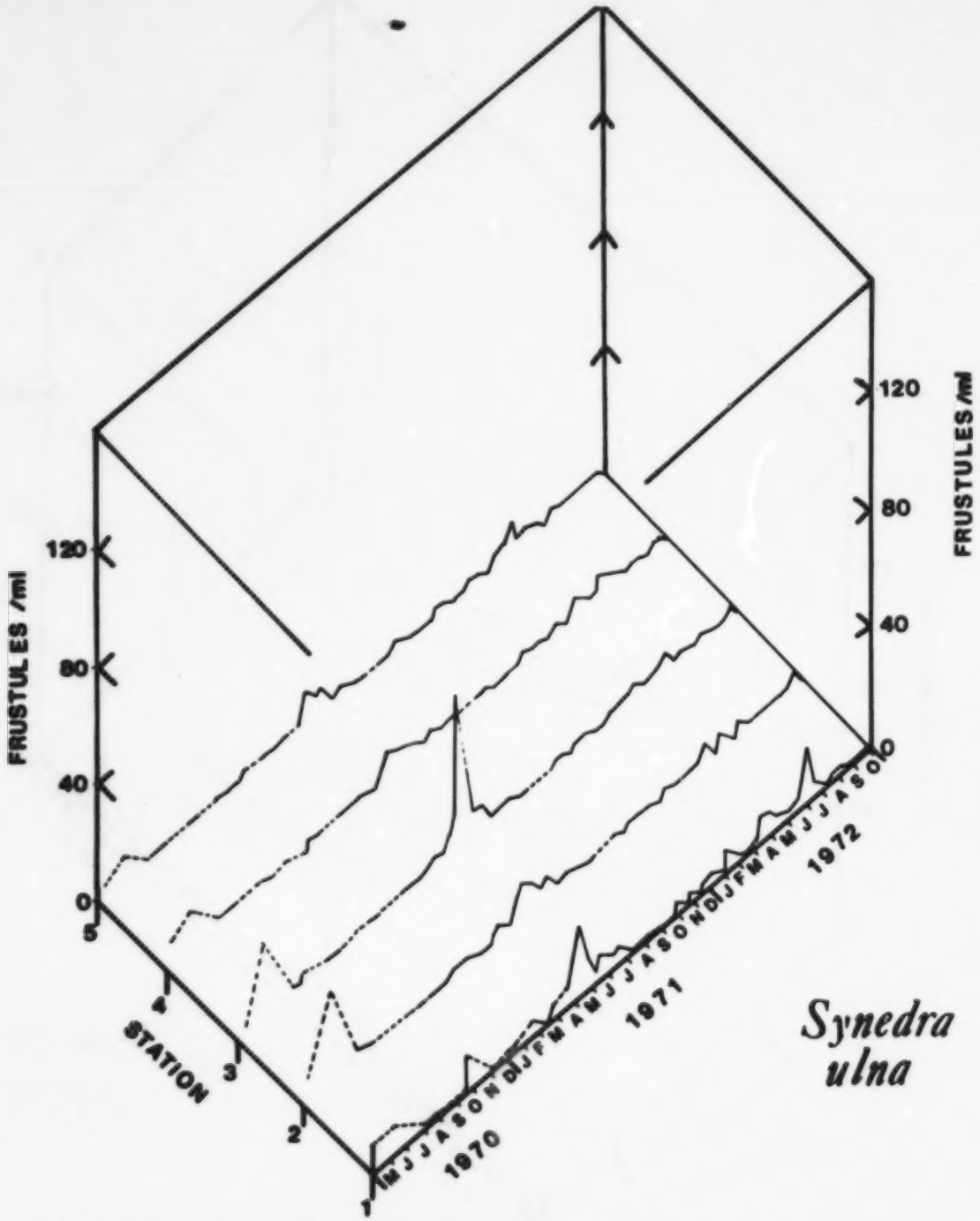

Figure A-23. Seasonal fluctuations of Synedra ulna at five stations across Lake Michigan, May 1970 - October 1972. (Broken lines between points indicate missing data.)

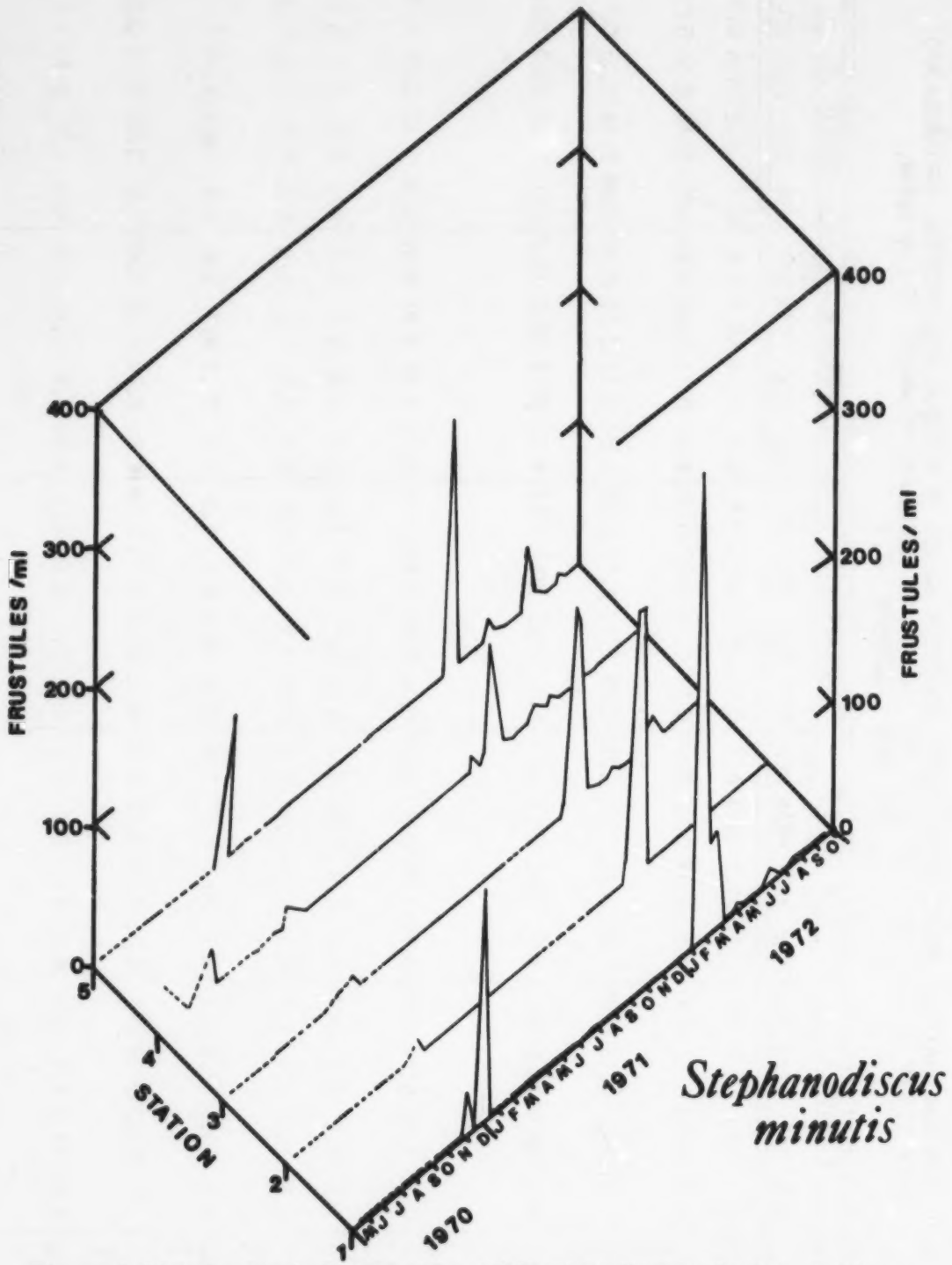

Figure A-24. Seasonal fluctuations of Stephanodiscus minutus at five stations across Lake Michigan, May 1970 - October 1972. (Broken lines between points indicate missing data.)

TABLE B-1. MINIMUM, MAXIMUM, MEAN, AND STANDARD DEVIATION VALUES OF PHYSICAL AND CHEMICAL VARIABLES AND MAJOR DIATOM SPECIES FROM FIVE STATIONS ACROSS LAKE MICHIGAN, MILWAUKEE TO LUDINGTON, MAY 1970 - OCTOBER 1972[1]

	STATION 1				STATION 2				STATION 3				STATION 4				STATION 5			
VARIABLE	MIN	MAX	MEAN	STD DEV	MIN	MAX	MEAN	STD DEV	MIN	MAX	MEAN	STD DEV	MIN	MAX	MEAN	STD DEV	MIN	MAX	MEAN	STD DEV
Temp (°C)	0.1	22.1	10.4	6.2	1.1	21.7	10.4	6.7	0.5	22.5	10.3	6.5	0.5	22.9	10.1	6.6	0.1	23.2	11.5	6.7
Phalk (meq/l)	N.D.	0.18	0.02	0.4	N.D.	0.17	0.02	0.04	N.D.	0.15	0.02	0.03	N.D.	0.13	0.02	0.03	N.D.	0.15	0.03	0.04
Totalk (meq/l)	2.06	2.25	2.13	0.04	2.03	2.16	2.11	0.03	2.05	2.17	2.12	0.03	2.04	2.17	2.12	0.02	2.06	2.43	2.13	0.52
Conduct (μmhos/cm at 25°C	N.D.	291.9	198.6	118.2	N.D.	270.0	193.7	115.3	N.D.	271.3	193.7	115.2	N.D.	273.1	193.6	115.2	N.D.	276.0	195.9	116.6
SiO_2 (mg/l)	0.10	1.60	0.79	0.40	0.10	1.50	0.87	0.44	0.10	1.50	0.89	0.41	0.02	1.40	0.87	0.42	0.30	1.40	0.79	0.39
pH	7.9	8.8	8.3	0.2	8.0	8.8	8.3	0.2	8.0	8.9	8.3	0.2	8.0	9.0	8.3	0.2	8.1	8.9	8.4	0.2
PO_4phos (μgP/l)	N.D.	10.8	2.1	1.7	N.D.	5.0	1.1	0.8	N.D.	2.4	0.9	0.5	N.D.	4.0	1.1	0.8	N.D.	4.3	1.1	0.8
Tot phos (μgP/l)	8.2	33.6	15.8	5.8	3.2	20.2	8.8	2.4	2.4	16.0	8.2	1.9	2.4	15.1	8.1	2.0	5.9	14.7	9.09	2.1
NO_3 (mgN/l)	N.D.	0.32	0.19	0.7	N.D.	0.28	0.18	0.06	N.D.	0.28	0.18	0.06	N.D.	0.28	0.18	0.06	N.D.	0.30	0.18	0.06
Chloro a (μg/l)[2]	N.D.	14.0	4.4	2.9	N.D.	5.2	2.2	1.1	N.D.	5.1	2.0	1.1	N.D.	4.8	1.9	1.0	N.D.	6.9	2.4	1.4

(Continued)

TABLE B-1 (CONTINUED)

VARIABLE	STATION 1				STATION 2				STATION 3				STATION 4				STATION 5			
	MIN	MAX	MEAN	STD DEV	MIN	MAX	MEAN	STD DEV	MIN	MAX	MEAN	STD DEV	MIN	MAX	MEAN	STD DEV	MIN	MAX	MEAN	STD DEV
Chloro (µg/l)	N.D.	10.9	1.8	1.7	N.D.	2.9	0.8	0.6	N.D.	1.8	0.6	0.5	N.D.	2.5	0.7	0.6	N.D.	9.2	0.9	1.2
Carot (µg/l)	N.D.	15.0	5.2	3.4	N.D.	5.6	2.5	1.2	N.D.	5.6	2.3	1.1	N.D.	4.9	2.2	1.1	N.D.	8.7	2.9	1.7
Actchloro a (µg/l)	N.D.	12.6	2.1	2.7	N.D.	3.9	1.0	1.1	N.D.	4.5	0.9	1.1	N.D.	3.9	0.9	1.0	N.D.	5.3	1.1	1.3
Phaeo (µg/l)	N.D.	5.3	1.4	1.7	N.D.	2.2	0.5	0.6	N.D.	2.1	0.4	0.5	N.D.	1.8	0.4	0.5	N.D.	4.1	0.7	0.9
C-14 (mgC/m^3/hr)	1.0	31.0	7.9	5.9	0.9	9.5	2.9	1.7	0.6	7.7	2.7	1.6	0.8	7.1	2.8	1.5	1.0	10.5	3.8	2.2
Total Diatoms	104	3112	411	498	35	1358	202	235	26	2594	305	464	27	1120	247	265	53	1152	289	289
Asterionella formosa	0	97	9	16	0	52	6	10	0	156	9	23	0	95	8	16	0	26	13	33
Cyclotella comta	0	16	2	3	0	10	1	2	0	14	2	2	0	24	2	5	0	8	1	2
Cyclotella michganiana	0	19	3	4	0	92	5	13	0	182	9	28	0	85	7	16	0	76	9	18
Cyclotella ocellata	0	32	5	7	0	71	5	10	0	54	5	11	0	63	6	12	0	68	4	10

(Continued)

TABLE B-1 (CONTINUED)

VARIABLE	STATION 1				STATION 2				STATION 3				STATION 4				STATION 5			
	MIN	MAX	MEAN	STD DEV	MIN	MAX	MEAN	STD DEV	MIN	MAX	MEAN	STD DEV	MIN	MAX	MEAN	STD DEV	MIN	MAX	MEAN	STD DEV
Cyclotella stelligera	0	42	6	10	0	300	22	55	0	2466	80	358	0	613	39	111	0	812	35	122
Diatoma tenue var. elongatum	0	67	4	13	0	19	1	3	0	30	1	4	0	4	<1	1	0	45	2	8
Fragillaria capcina	0	117	12	22	0	14	1	3	0	16	1	2	0	11	1	2	0	44	4	9
Fragillaria construens	0	159	16	34	0	165	5	23	0	94	3	14	0	82	2	12	0	325	14	50
Fragillaria crotonensis	0	268	65	56	0	220	39	46	0	277	43	61	0	463	49	87	<1	325	63	69
Fragillaria pinnata	0	73	10	17	0	6	1	1	0	11	1	2	0	14	2	3	0	48	2	7
Fragillaria sp. 1	0	27	3	5	0	14	1	3	0	19	1	3	0	9	1	2	0	10	2	2
Melosira ambigua	0	53	4	11	0	16	1	3	0	26	1	4	0	32	2	6	0	53	4	10

(Continued)

TABLE B-1 (CONTINUED)

VARIABLE	STATION 1				STATION 2				STATION 3				STATION 4				STATION 5			
	MIN	MAX	MEAN	STD DEV	MIN	MAX	MEAN	STD DEV	MIN	MAX	MEAN	STD DEV	MIN	MAX	MEAN	STD DEV	MIN	MAX	MEAN	STD DEV
Melosira islandica	0	192	28	44	0	70	13	17	0	77	16	21	0	100	17	24	0	53	12	16
Melosira italica	0	142	24	28	0	82	22	24	0	115	24	29	0	127	23	30	0	84	18	20
Rhizosolenia eriensis	0	225	8	38	0	501	24	95	0	753	48	161	0	578	22	104	0	403	22	74
Stephanodiscus alpinus	0	54	12	13	0	49	5	8	0	111	5	16	0	22	4	5	0	48	6	9
Stephanodiscus hantzschii	0	2542	97	386	0	185	5	26	0	30	2	6	0	13	1	3	0	513	13	72
Stephanodiscus minutus	0	363	14	57	0	200	8	38	0	148	6	28	0	82	3	13	0	184	8	30
Synedra radians	0	78	3	11	0	78	3	11	0	76	5	14	0	85	4	16	0	64	4	10
Synedra ulna	0	25	3	5	0	29	2	4	0	50	3	8	0	8	1	2	0	10	1	2

(Continued)

TABLE B-1 (CONTINUED)

VARIABLE	STATION 1				STATION 2				STATION 3				STATION 4				STATION 5			
	MIN	MAX	MEAN	STD DEV	MIN	MAX	MEAN	STD DEV	MIN	MAX	MEAN	STD DEV	MIN	MAX	MEAN	STD DEV	MIN	MAX	MEAN	STD DEV
Tabellaria flocculosa	0	349	52	65	<1	87	16	19	<1	88	10	13	0	53	8	10	2	296	21	44

[1]Physical and chemical data were calculated from 62 samples per station and diatom data were calculated from 50 or 51 samples per station; daitoms are in frustules/ml).

TABLE B-2. ABUNDANCE (IN FRUSTULES/ML) OF MAJOR DIATOM SPECIES AT STATION 1, MAY 1970 - OCTOBER 1972

Date	Total Diatoms	Melosira italica	Rhizosolenia eriensis	Fragilaria capucina	Melosira islandica
270570	514	14	32	0	19
80670	M	M	M	M	M
160670	M	M	M	M	M
260670	3112	11	255	0	9
80770	M	M	M	M	M
200770	M	M	M	M	M
110870	134	<1	0	4	0
210870	176	0	<1	9	<1
20970	325	0	0	14	0
140970	M	M	M	M	M
280970	M	M	M	M	M
81070	M	M	M	M	M
221070	202	1	<1	0	<1
31170	1302	8	0	117	8
161170	M	M	M	M	M
281170	M	M	M	M	M
91270	578	15	21	10	3
221270	388	26	1	3	5
60171	481	34	3	0	6
100171	302	39	0	0	11
30271	M	M	M	M	M
110371	151	25	0	0	27
240371	249	28	0	0	34
60471	123	21	0	0	13
160471	M	M	M	M	M
300471	150	35	0	0	58
110571	159	22	0	2	90
250571	1504	61	0	5	179
30671	112	20	0	2	28
160671	131	4	<1	2	11
280671	264	4	0	7	4
190771	513	4	0	74	10
290771	214	<1	0	17	4
170871	219	2	0	10	<1
310871	M	M	M	M	M
100971	260	<1	0	30	0
221071	104	9	0	<1	1
61171	148	6	0	9	10
201071	558	26	0	31	19
131171	340	3	0	52	36
11271	306	19	0	19	28
121271	196	42	0	5	35
221271	264	43	0	17	38
120172	248	47	0	6	36

(Continued)

TABLE B-2 (CONTINUED)

Date	Total Diatoms	Melosira italica	Rhizosolenia eriensis	Fragilaria capucina	Melosira islandica
80272	203	43	0	1	35
220272	960	64	4	0	78
140272	452	68	0	1	47
290372	214	27	2	0	22
110472	154	41	0	0	49
270472	592	142	0	0	192
90572	655	70	0	0	171
210572	106	18	0	2	50
70672	153	91	0	0	30
210672	232	8	6	27	17
90772	1294	21	97	55	4
250772	481	0	0	32	0
160872	137	0	0	2	0
240872	174	<1	0	0	<1
90972	298	<1	<1	<1	<1
230972	264	3	0	2	2
41072	258	8	0	11	4
271072	197	19	0	2	2

Date	Asterionella formosa	Cyclotella michiganiana	Tabellaria flocculosa	Synedra ulna	Fragilaria crotonensis
270570	32	0	81	10	187
80670	M	M	M	M	M
160670	M	M	M	M	M
260670	0	0	106	9	84
80770	M	M	M	M	M
200770	M	M	M	M	M
110870	4	4	16	0	46
210870	23	6	16	0	98
20970	27	9	86	0	172
140970	M	M	M	M	M
280970	M	M	M	M	M
81070	M	M	M	M	M
221070	15	19	15	<1	97
31170	20	16	349	8	268
161170	M	M	M	M	M
281170	M	M	M	M	M
91270	31	7	60	0	186
221270	2	3	55	<1	71
60171	12	8	30	<1	100
100171	<1	3	36	<1	43
30271	M	M	M	M	M
110371	0	2	8	4	32
240371	<1	2	4	0	28

(Continued)

TABLE B-2 (CONTINUED)

Date	Asterionella formosa	Cyclotella michiganiana	Tabellaria flocculosa	Synedra ulna	Fragilaria crotonensis
60471	0	3	36	1	43
160471	M	M	M	M	M
300471	0	0	10	6	14
110571	0	<1	3	12	11
250571	5	0	34	25	62
30671	0	0	15	9	11
160671	1	0	17	4	23
280671	<1	0	31	7	44
190771	14	0	78	3	113
290771	<1	<1	129	4	45
170871	13	4	25	0	86
310871	M	M	M	M	M
100971	7	1	9	0	119
221071	9	3	20	0	37
61171	<1	1	69	9	25
201071	26	8	76	3	109
131171	3	6	86	0	118
11271	2	2	49	<1	58
121271	<1	3	12	0	32
221271	0	0	26	<1	37
120172	0	<1	14	2	33
80272	1	2	4	<1	22
220272	21	0	28	4	25
140272	3	0	13	1	17
290372	6	5	23	0	9
110472	0	<1	1	<1	2
270472	0	2	25	6	40
90572	2	2	22	6	64
210572	0	<1	5	4	7
70672	0	0	6	3	3
210672	1	<1	92	5	18
90772	97	17	84	17	76
250772	3	2	271	5	104
160872	23	2	37	0	62
240872	7	<1	36	<1	78
90972	35	1	63	<1	153
230972	3	<1	142	0	77
41072	6	0	129	0	72
271072	2	<1	76	0	32

Date	Cyclotella stelligera	Stephanodiscus minutus	Stephanodiscus hantzschii	Cyclotella comta	Fragilaria construens
270570	11	0	35	0	3
80670	M	M	M	M	M

(Continued)

TABLE B-2 (CONTINUED)

Date	Cyclotella stelligera	Stephan-odiscus minutus	Stephan-odiscus hantzschii	Cyclotella comta	Fragilaria construens
160670	M	M	M	M	M
260670	0	0	2542	0	0
80770	M	M	M	M	M
200770	M	M	M	M	M
110870	6	0	0	2	0
210870	0	0	2	3	0
20970	0	0	2	2	0
140970	M	M	M	M	M
280970	M	M	M	M	M
81070	M	M	M	M	M
221070	21	0	5	3	0
31170	16	0	268	4	8
161170	M	M	M	M	M
281170	M	M	M	M	M
91270	27	29	45	2	0
221270	0	0	1	1	70
60171	37	174	3	1	1
100171	9	<1	14	<1	24
30271	M	M	M	M	M
110371	3	0	0	0	0
240371	21	0	2	0	21
60471	15	0	0	0	<1
160471	M	M	M	M	M
300471	0	0	0	0	1
110571	0	0	3	0	0
250571	17	0	900	0	0
30671	0	0	6	<1	0
160671	<1	0	28	0	0
280671	<1	0	95	0	4
190771	5	0	29	0	4
290771	4	0	<1	0	0
170871	0	0	9	1	9
310871	M	M	M	M	M
100971	0	0	0	16	0
221071	<1	0	2	10	2
61171	0	0	0	6	0
201071	2	0	44	8	46
131171	0	0	<1	7	<1
11271	<1	0	5	3	70
121271	1	0	2	2	18
221271	4	0	21	5	0
120172	6	0	13	1	31
80272	8	0	9	0	5
220272	0	363	78	4	128

(Continued)

TABLE B-2 (CONTINUED)

Date	Cyclotella stelligera	Stephan-odiscus minutus	Stephan-odiscus hantzschii	Cyclotella comta	Fragilaria construens
140272	10	65	14	6	101
290372	18	69	<1	<1	3
110472	1	<1	<1	<1	25
270472	2	0	0	4	37
90572	4	2	6	4	159
210572	2	1	7	<1	<1
70672	<1	0	0	0	0
210672	<1	<1	11	0	3
90772	42	21	649	4	0
250772	2	0	8	5	0
160872	3	0	1	2	0
240872	2	<1	<1	2	7
90972	12	0	0	4	6
230972	<1	0	0	2	5
41072	0	0	0	0	0
271072	1	0	2	0	16

Date	Synedra radians	Stephan-odiscus alpinus	Melosira ambigua	Cyclotella ocellata	Fragilaria Sp. 1
270570	0	0	0	3	8
80670	M	M	M	M	M
160670	M	M	M	M	M
260670	0	0	9	0	0
80770	M	M	M	M	M
200770	M	M	M	M	M
110870	0	<1	0	0	0
210870	0	<1	0	<1	<1
20970	0	0	0	2	0
140970	M	M	M	M	M
280970	M	M	M	M	M
81070	M	M	M	M	M
221070	0	<1	3	3	0
31170	0	20	12	32	8
161170	M	M	M	M	M
281170	M	M	M	M	M
91270	0	15	14	7	3
221270	0	33	1	6	3
60171	0	10	0	6	0
100171	0	34	3	2	<1
30271	M	M	M	M	M
110371	0	24	0	2	4
240371	2	54	0	1	6

(Continued)

TABLE B-2 (CONTINUED)

Date	Synedra radians	Stephanodiscus alpinus	Melosira ambigua	Cyclotella ocellata	Fragilaria Sp. 1
60471	6	17	0	<1	2
160471	M	M	M	M	M
300471	4	6	0	<1	4
110571	2	3	0	0	9
250571	78	17	0	0	5
30671	5	<1	0	0	<1
160671	11	6	2	1	0
280671	6	3	8	<1	3
190771	6	3	53	30	1
290771	4	0	0	2	0
170871	0	5	9	8	<1
310871	M	M	M	M	M
100971	0	6	9	2	0
221071	0	2	3	<1	<1
61171	0	7	<1	1	<1
201071	0	27	51	5	0
131171	0	7	9	4	0
11271	0	13	9	11	4
121271	2	10	1	6	5
221271	<1	15	<1	12	2
120172	<1	24	1	5	1
80272	0	35	<1	10	1
220272	0	46	0	0	0
140272	1	25	0	11	3
290372	<1	6	<1	6	2
110472	1	9	0	4	2
270472	4	29	16	6	27
90572	2	24	0	4	16
210572	2	5	0	1	0
70672	6	<1	0	4	2
210672	8	3	1	1	1
90772	15	17	0	15	4
250772	8	2	0	16	0
160872	0	<1	0	2	0
240872	0	3	0	1	1
90972	0	<1	1	2	0
230972	0	4	<1	8	0
41072	0	9	0	13	0
271072	0	11	2	9	1

Date	Fragilaria pinnata	Diatoma tenue var. elongatum
270570	3	0
80670	M	M

(Continued)

TABLE B-2 (CONTINUED)

Date	Fragilaria pinnata	Diatoma tenue var. elongatum
160670	M	M
260670	0	0
80770	M	M
200770	M	M
110870	0	<1
210870	0	<1
20970	0	<1
140970	M	M
280970	M	M
81070	M	M
221070	0	<1
31170	24	0
161170	M	M
281170	M	M
91270	25	0
221270	51	0
60171	6	1
110171	24	0
30271	M	M
110371	9	0
240371	19	0
60471	11	0
160471	M	M
300471	10	0
110571	1	0
250571	27	67
30671	0	<1
160671	4	10
280671	4	25
190771	0	59
290771	0	2
170871	3	2
310871	M	M
100971	0	0
221071	2	0
61171	3	0
201071	19	0
131171	0	0
11271	43	0
121271	5	0
221271	2	0
120172	1	0
80272	5	0
220272	53	4
140272	43	0

(Continued)

TABLE B-2 (CONTINUED)

Date	Fragilaria pinnata	Diatoma tenue var. elongatum
290372	<1	0
110472	9	0
270472	31	0
90572	73	0
210572	0	0
70672	0	0
210672	3	0
90772	0	25
250772	0	8
160872	0	0
240872	4	0
90972	3	0
230972	2	0
41072	0	0
271072	7	0

M = Data Missing.

TABLE B-3. ABUNDANCE (IN FRUSTULES/ML) OF MAJOR DIATOM SPECIES AT STATION 2, MAY 1970 - OCTOBER 1972

Date	Total Diatoms	Melosira italica	Rhizosolenia eriensis	Fragilaria capucina	Melosira islandica
270570	260	32	62	4	18
80670	M	M	M	M	M
160670	M	M	M	M	M
260670	1358	4	501	0	4
80770	M	M	M	M	M
200770	M	M	M	M	M
110870	468	0	0	0	0
210870	84	<1	0	1	<1
20970	143	0	<1	14	2
140970	M	M	M	M	M
280970	M	M	M	M	M
81070	M	M	M	M	M
221070	254	<1	3	0	0
31170	240	<1	5	5	<1
161170	M	M	M	M	M
281170	M	M	M	M	M
91270	214	18	7	2	1
221270	156	15	2	0	1
60171	84	16	1	0	<1
190171	156	29	<1	1	5
30271	75	24	0	<1	3
110371	103	27	0	0	10
240371	94	18	<1	0	12
60471	78	26	0	0	19
160471	156	79	0	0	38
300471	61	19	0	0	30
110571	58	32	0	0	23
250571	178	77	0	0	70
30671	158	62	0	0	70
160671	490	22	161	0	22
280671	84	1	<1	<1	<1
190771	458	0	0	0	1
290771	250	0	0	6	0
170871	309	0	0	0	0
310871	M	M	M	M	M
100971	70	<1	0	5	0
220971	35	<1	0	<1	<1
61071	M	M	M	M	M
201071	183	1	0	6	<1
131171	105	5	0	<1	1
11271	81	13	0	2	3
121271	140	22	0	<1	10
221271	86	17	0	<1	10
120172	111	34	<1	0	16

(Continued)

TABLE B-3 (CONTINUED)

Date	Total Diatoms	Melosira italica	Rhizosolenia eriensis	Fragilaria capucina	Melosira islandica
80272	139	38	2	0	11
220272	425	24	14	0	30
140372	416	46	3	0	18
290372	96	41	0	0	26
110472	78	39	0	0	23
270472	121	63	0	0	30
90572	164	68	0	1	45
210572	150	82	0	0	36
70672	104	15	<1	8	24
210672	157	67	<1	3	28
90772	1026	22	446	0	0
250772	240	0	34	4	0
160872	100	0	0	1	0
240872	44	0	<1	<1	<1
90972	37	0	<1	<1	<1
230972	112	<1	0	<1	0
41072	46	<1	0	<1	<1
271072	90	3	0	<1	0

Date	Asterionella formosa	Cyclotella michiganiana	Tabellaria flocculosa	Synedra ulna	Fragilaria crotonensis
270570	22	0	10	5	22
80670	M	M	M	M	M
160670	M	M	M	M	M
260670	10	<1	87	29	198
80770	M	M	M	M	M
200770	M	M	M	M	M
110870	4	92	1	1	45
210870	2	4	3	0	60
20970	9	14	12	0	72
140970	M	M	M	M	M
280970	M	M	M	M	M
81070	M	M	M	M	M
221070	7	15	31	0	165
31170	23	6	81	0	77
161170	M	M	M	M	M
281170	M	M	M	M	M
91270	12	8	33	0	87
221270	12	6	21	<1	58
60171	5	1	9	<1	20
190171	5	<1	16	0	32
30271	0	<1	12	<1	19
110371	0	<1	7	<1	19
240371	1	<1	3	0	14

(Continued)

TABLE B-3 (CONTINUED)

Date	Asterionella formosa	Cyclotella michiganiana	Tabellaria flocculosa	Synedra ulna	Fragilaria crotonensis
60471	0	<1	5	0	9
160471	0	<1	7	2	7
300471	0	0	2	3	1
110571	0	0	<1	<1	0
250571	0	0	2	8	2
30671	0	0	4	10	2
160671	31	0	7	9	34
280671	2	<1	3	5	39
190771	9	3	16	6	220
290771	4	4	66	2	100
170871	6	16	6	<1	69
310871	M	M	M	M	M
110971	2	<1	20	0	28
220971	2	1	5	0	9
61071	M	M	M	M	M
201071	52	8	39	<1	56
131171	18	7	22	0	58
11271	2	3	18	<1	32
121271	4	4	18	<1	48
221271	<1	4	10	<1	28
120172	2	3	6	<1	20
80272	5	<1	5	0	17
220272	6	5	3	2	11
140372	3	5	5	0	3
290372	0	0	1	<1	4
110472	0	<1	2	<1	<1
270472	0	<1	2	2	8
90572	0	<1	6	4	7
210572	0	0	5	1	<1
70672	0	<1	24	4	13
210672	<1	<1	5	<1	6
90772	21	0	4	3	48
250772	18	19	13	1	34
160872	6	<1	36	0	51
240872	0	2	8	0	26
90972	3	<1	9	0	11
230972	9	<1	45	0	48
41072	6	<1	8	0	22
271072	1	<1	43	<1	24

Date	Cyclotella stelligera	Stephan-odiscus minutus	Stephan-odiscus hantzschii	Cyclotella comta	Fragilaria construens
270570	0	0	6	0	22
80670	M	M	M	M	M

(Continued)

TABLE B-3 (CONTINUED)

Date	Cyclotella stelligera	Stephan-odiscus minutus	Stephan-odiscus hantzschii	Cyclotella comta	Fragilaria construens
160670	M	M	M	M	M
260670	10	0	185	0	0
80770	M	M	M	M	M
200770	M	M	M	M	M
110870	300	0	0	4	0
210870	0	0	<1	<1	0
20970	0	0	<1	0	0
140970	M	M	M	M	M
280970	M	M	M	M	M
81070	M	M	M	M	M
221070	11	0	0	0	165
31170	4	0	6	5	0
161170	M	M	M	M	M
281170	M	M	M	M	M
91270	6	0	6	2	0
221270	7	6	6	<1	<1
60171	4	6	0	<1	0
190171	5	0	1	<1	3
30271	<1	0	<1	<1	<1
110371	11	0	<1	<1	<1
240371	14	0	<1	<1	0
60471	4	0	0	<1	<1
160471	<1	0	0	0	0
300471	0	0	0	0	0
110571	<1	0	0	0	0
250571	<1	0	0	0	0
30671	0	0	0	0	0
160671	42	0	7	0	0
280671	1	0	1	0	0
190771	167	0	1	0	0
290771	52	0	0	<1	0
170871	196	0	<1	10	0
310871	M	M	M	M	M
100971	<1	0	<1	2	0
220971	5	0	<1	4	<1
61071	M	M	M	M	M
201071	0	0	3	4	0
131171	1	0	0	2	0
11271	<1	0	<1	1	0
121271	2	0	<1	<1	9
221271	<1	0	0	<1	3
120172	2	0	0	<1	6
80272	12	19	0	<1	4
220272	56	200	3	0	8

(Continued)

TABLE B-3 (CONTINUED)

Date	Cyclotella stelligera	Stephan-odiscus minutus	Stephan-odiscus hantzschii	Cyclotella comta	Fragilaria construens
140372	83	192	6	2	5
290372	<1	<1	0	<1	7
110472	1	0	0	0	0
270472	<1	0	0	<1	<1
90572	2	2	0	<1	10
210572	0	<1	0	0	0
70672	<1	1	1	0	0
210672	<1	0	0	1	0
90772	41	0	0	0	3
250772	58	1	20	<1	0
160872	<1	0	0	2	0
240872	2	0	<1	2	<1
90972	8	0	0	3	<1
230972	<1	0	0	1	0
41072	<1	0	0	3	0
271072	0	0	0	3	1

Date	Synedra radians	Stephan-odiscus alpinus	Melosira ambigua	Cyclotella ocellata	Fragilaria Sp. 1
270570	0	14	1	5	0
80670	M	M	M	M	M
160670	M	M	M	M	M
260670	0	10	16	16	0
80770	M	M	M	M	M
200770	M	M	M	M	M
110870	0	0	0	1	0
210870	0	0	<1	<1	0
20970	0	0	1	<1	0
140970	M	M	M	M	M
280970	M	M	M	M	M
81070	M	M	M	M	M
221070	0	0	0	2	0
31170	0	<1	0	12	0
161170	M	M	M	M	M
281170	M	M	M	M	M
91270	0	1	1	4	0
221270	<1	3	1	4	0
60171	0	5	0	4	0
190171	<1	18	<1	3	0
30271	<1	7	<1	<1	1
110371	1	11	0	1	2
240371	1	14	0	1	0

(Continued)

TABLE B-3 (CONTINUED)

Date	Synedra radians	Stephanodiscus alpinus	Melosira ambigua	Cyclotella ocellata	Fragilaria Sp. 1
60471	0	5	0	<1	1
160471	4	4	0	2	3
300471	<1	<1	0	<1	2
110571	0	0	0	0	<1
250571	1	<1	0	<1	10
30671	2	0	0	3	3
160671	18	49	0	5	0
280671	17	<1	3	4	0
190771	9	0	0	17	0
290771	0	0	<1	12	0
170871	0	<1	2	<1	0
310871	M	M	M	M	M
100971	0	1	1	<1	0
220971	0	1	1	<1	0
61071	M	M	M	M	M
201071	<1	1	4	<1	0
131171	0	<1	3	4	0
11271	0	<1	<1	2	0
121271	3	3	3	4	2
221271	0	4	0	2	<1
120172	<1	8	<1	0	0
80272	0	12	0	12	0
220272	2	19	11	2	5
140372	2	10	0	5	5
290372	<1	3	0	1	1
110472	<1	1	0	4	1
270472	2	<1	2	4	1
90572	2	2	0	0	2
210572	2	0	0	2	8
70672	2	<1	0	2	1
210672	16	1	0	6	14
90772	78	21	3	71	0
250772	1	<1	0	9	0
160872	0	0	0	2	0
240872	0	<1	<1	1	0
90972	0	<1	0	<1	0
230972	0	<1	<1	1	0
41072	0	<1	0	3	0
271072	0	0	<1	8	1

Date	Fragilaria pinnata	Diatoma tenue var. elongatum
270570	0	0
80670	M	M

(Continued)

TABLE B-3 (CONTINUED)

Date	Fragilaria pinnata	Diatoma tenue var. elongatum
160670	M	M
260670	0	4
80770	M	M
200770	M	M
110870	0	0
210870	0	0
20970	<1	1
140970	M	M
280970	M	M
81070	M	M
221070	0	0
31170	0	1
161170	M	M
281170	M	M
91270	3	2
221270	0	0
60171	<1	<1
190171	6	0
30271	0	0
110371	<1	0
240371	0	<1
60471	0	0
160471	0	0
300471	0	0
110571	<1	0
250571	2	0
30671	0	0
160671	0	2
280671	<1	1
190771	0	5
290771	0	<1
170871	0	0
310871	M	M
100971	0	0
220971	<1	0
61071	M	M
201071	<1	0
131171	0	0
11271	0	0
121271	5	0
221271	<1	0
120172	1	0
80272	0	0
220272	5	0
140372	2	0

(Continued)

TABLE B-3 (CONTINUED)

Date	Fragilaria pinnata	Diatoma tenue var. elongatum
290372	<1	0
110472	0	0
270472	0	0
90572	3	0
210572	0	0
70672	0	0
210672	0	0
90772	0	7
250772	0	19
160872	0	0
240872	<1	<1
90972	<1	0
230972	0	0
41072	<1	0
271072	<1	0

M = Data Missing

TABLE B-4. ABUNDANCE (IN FRUSTULES/ML) OF MAJOR DIATOM SPECIES AT STATION 3, MAY 1970 - OCTOBER 1972

Date	Total Diatoms	Melosira italica	Rhizosolenia eriensis	Fragilaria capucina	Melosira islandica
270570	286	43	65	0	45
80670	M	M	M	M	M
160670	M	M	M	M	M
260670	1301	14	753	0	23
80770	M	M	M	M	M
200770	M	M	M	M	M
110870	748	0	0	0	0
210870	117	0	<1	1	0
20970	58	<1	<1	<1	<1
140970	M	M	M	M	M
280970	M	M	M	M	M
81070	M	M	M	M	M
221070	162	1	2	7	0
31170	410	5	4	16	<1
161170	M	M	M	M	M
281170	M	M	M	M	M
91270	130	8	5	0	<1
221270	M	M	M	M	M
60171	650	13	<1	<1	<1
190171	91	25	0	<1	2
30271	M	M	M	M	M
110371	66	19	<1	0	9
240371	50	32	0	0	14
60471	93	28	0	0	23
160471	97	36	0	0	33
300471	110	38	0	0	49
110571	107	45	0	0	47
250571	167	66	0	0	77
30671	212	82	0	0	59
160671	1558	55	716	0	35
280671	121	7	<1	0	5
190771	350	3	0	0	3
290771	408	0	0	0	0
170871	108	0	0	<1	<1
310871	81	<1	0	<1	0
100971	52	<1	0	<1	1
220971	80	0	0	<1	0
60171	M	M	M	M	M
201071	170	<1	0	4	0
131171	112	3	0	0	<1
11271	161	14	<1	<1	<1
121271	124	15	0	0	5
221271	215	2	0	0	9
120172	53	15	0	0	15

(Continued)

TABLE B-4 (CONTINUED)

Date	Total Diatoms	Melosira italica	Rhizosolenia eriensis	Fragilaria capucina	Melosira islandica
80272	90	25	<1	0	15
220272	397	47	4	3	20
140372	329	30	4	0	36
290372	54	25	0	0	18
110472	74	36	0	0	21
270472	97	53	0	0	16
90572	142	60	0	0	40
210572	224	111	0	0	68
70672	195	115	0	0	51
210672	351	75	95	1	40
90772	864	45	480	0	3
250772	1076	0	245	0	0
160872	2594	5	0	0	0
240872	44	<1	0	0	0
90972	43	<1	0	0	<1
230972	26	<1	0	<1	0
41072	128	1	0	0	0
271072	74	6	0	<1	<1

Date	Asterionella formosa	Cyclotella michiganiana	Tabellaria flocculosa	Synedra ulna	Fragilaria crotonensis
270570	22	<1	9	2	12
80670	M	M	M	M	M
160670	M	M	M	M	M
260670	14	0	14	23	32
80770	M	M	M	M	M
200770	M	M	M	M	M
110870	0	182	3	0	17
210870	2	63	<1	0	23
20970	4	11	4	<1	12
140970	M	M	M	M	M
280970	M	M	M	M	M
81070	M	M	M	M	M
221070	9	11	29	0	77
31170	21	19	88	0	202
161170	M	M	M	M	M
281170	M	M	M	M	M
91270	5	2	16	<1	44
221270	M	M	M	M	M
60171	3	<1	6	1	14
190171	0	2	13	<1	28
30271	M	M	M	M	M
110371	<1	<1	5	<1	11
240371	0	<1	<1	<1	0

(Continued)

TABLE B-4 (CONTINUED)

Date	Asterionella formosa	Cyclotella michiganiana	Tabellaria flocculosa	Synedra ulna	Fragilaria crotonensis
60471	0	<1	8	<1	15
160471	0	<1	7	1	7
300471	0	0	5	3	6
110571	0	<1	3	3	<1
250571	0	<1	4	7	3
30671	0	0	6	13	27
160671	156	0	5	50	186
280671	0	0	5	8	59
190771	6	2	6	7	245
290771	6	19	3	1	277
170871	3	6	3	<1	71
310871	9	<1	14	<1	46
100971	2	2	1	0	4
220971	7	2	6	0	19
61071	M	M	M	M	M
201071	24	8	8	0	72
131171	14	6	16	0	61
11271	21	8	14	<1	89
121271	<1	8	14	0	44
221271	6	6	12	<1	44
120172	1	1	4	<1	18
80272	2	2	4	0	14
220272	19	7	11	0	27
140372	4	1	4	1	8
290372	0	<1	3	<1	<1
110472	0	<1	1	<1	1
270472	0	<1	3	3	3
90572	0	<1	8	<1	6
210572	0	0	6	1	3
70672	0	<1	2	3	0
210672	0	0	16	5	41
90772	32	38	6	0	42
250772	26	38	8	<1	68
160872	10	5	5	0	59
240872	<1	3	4	<1	18
90972	2	0	15	0	16
230972	3	<1	10	0	6
41072	16	1	34	0	65
271072	8	1	24	<1	20

Date	Cyclotella stelligera	Stephanodiscus minutus	Stephanodiscus hantzschii	Cyclotella comta	Fragilaria construens
270570	2	0	0	0	0
80670	M	M	M	M	M

(Continued)

TABLE B-4 (CONTINUED)

Date	Cyclotella stelligera	Stephan-odiscus minutus	Stephan-odiscus hantzschii	Cyclotella comta	Fragilaria construens
160670	M	M	M	M	M
260670	14	0	0	0	0
80770	M	M	M	M	M
200770	M	M	M	M	M
110870	467	0	0	4	0
210870	0	0	0	3	0
20970	0	<1	0	2	0
140970	M	M	M	M	M
280970	M	M	M	M	M
81070	M	M	M	M	M
221070	6	0	5	<1	0
31170	8	0	0	2	0
161170	M	M	M	M	M
281170	M	M	M	M	M
91270	9	2	12	<1	2
221270	M	M	M	M	M
60171	4	5	<1	<1	<1
190171	2	0	0	<1	<1
30271	M	M	M	M	M
110371	4	0	<1	1	0
240371	<1	0	0	<1	0
60471	1	0	0	0	0
160471	<1	0	0	0	0
300471	<1	0	0	0	0
100571	0	0	0	0	0
250571	0	0	0	0	0
30671	<1	0	0	0	0
160671	55	0	0	0	0
280671	2	2	1	0	0
190771	50	0	0	0	0
290771	97	0	0	1	0
170871	<1	0	<1	14	3
310871	4	0	<1	5	0
100971	36	0	2	3	0
220971	13	0	11	5	3
61071	M	M	M	M	M
201071	5	0	1	2	1
131171	<1	0	<1	3	0
11271	2	0	<1	<1	<1
121271	<1	0	<1	2	12
221271	<1	0	1	<1	94
120172	<1	0	0	0	1
80272	4	6	0	<1	3
220272	73	148	0	0	3

(Continued)

TABLE B-4 (CONTINUED)

Date	Cyclotella stelligera	Stephan-odiscus minutus	Stephan-odiscus hantzschii	Cyclotella comta	Fragilaria construens
140372	68	133	2	1	4
290372	<1	<1	0	<1	1
110472	2	0	0	<1	0
270472	1	0	0	<1	<1
90572	3	1	0	<1	<1
210572	0	0	0	0	0
70672	1	0	0	1	<1
210672	8	0	0	0	0
90772	70	0	30	0	0
250772	516	15	30	4	22
160872	2466	0	0	5	0
240872	3	<1	0	4	2
90972	2	0	<1	2	0
230972	<1	0	0	2	<1
41072	1	0	0	3	0
271072	2	<1	0	2	1

Date	Synedra radians	Stephan-odiscus alpinus	Melosira ambigua	Cyclotella ocellata	Fragilaria Sp. 1
270570	0	8	0	3	0
80670	M	M	M	M	M
160670	M	M	M	M	M
260670	0	0	0	0	0
80770	M	M	M	M	M
200770	M	M	M	M	M
110870	0	0	6	0	0
210870	0	0	0	<1	0
20970	0	<1	1	<1	0
140970	M	M	M	M	M
280970	M	M	M	M	M
81070	M	M	M	M	M
221070	0	0	2	4	<1
31170	0	1	3	14	0
161170	M	M	M	M	M
281170	M	M	M	M	M
91270	0	<1	1	1	0
221270	M	M	M	M	M
60171	0	3	1	3	<1
190171	<1	6	0	3	<1
30271	M	M	M	M	M
110371	1	6	0	<1	<1
240371	0	<1	0	<1	<1

(Continued)

TABLE B-4 (CONTINUED)

Date	Synedra radians	Stephan-odiscus alpinus	Melosira ambigua	Cyclotella ocellata	Fragilaria Sp. 1
60471	2	6	0	<1	2
160471	3	1	0	<1	<1
300471	2	<1	0	<1	3
110571	<1	<1	0	<1	4
250571	1	<1	0	<1	6
30671	11	<1	0	2	9
160671	76	111	0	10	0
280671	19	0	4	5	0
190771	2	<1	<1	22	0
290771	0	0	0	3	0
170871	0	<1	2	<1	0
310871	0	0	0	0	0
100971	0	<1	<1	1	<1
220971	0	2	3	<1	<1
61071	M	M	M	M	M
201071	<1	4	26	<1	0
121171	0	0	5	2	0
11271	<1	<1	<1	2	0
121271	<1	1	2	5	<1
221271	0	3	0	5	<1
120172	<1	1	0	2	<1
80272	1	7	0	1	<1
220272	0	15	4	4	0
140372	1	7	0	4	0
290372	<1	1	<1	<1	<1
110472	<1	3	<1	2	0
270472	3	<1	0	7	2
90572	4	4	<1	3	2
210572	4	2	<1	<1	19
70672	1	1	0	3	10
210672	25	15	0	6	2
90772	67	35	0	54	0
250772	11	15	4	38	0
160872	0	0	0	39	0
240872	0	0	0	5	0
90972	<1	<1	<1	<1	0
230972	0	<1	<1	<1	0
41072	0	<1	0	2	0
271072	<1	0	0	8	0

Date	Fragilaria pinnata	Diatoma tenue var. elongatum
270570	0	0
80670	M	M

(Continued)

TABLE B-4 (CONTINUED)

Date	Fragilaria pinnata	Diatoma tenue var. elongatum
160670	M	M
260670	0	0
80770	M	M
200770	M	M
110870	0	0
210870	0	0
20970	<1	0
140970	M	M
280970	M	M
81070	M	M
221070	0	<1
31170	1	4
161170	M	M
281170	M	M
91270	<1	<1
221270	M	M
60171	3	<1
190171	<1	0
30271	M	M
110371	<1	0
240371	<1	0
60471	0	0
160471	0	0
300471	0	0
110571	0	0
250571	0	0
30671	0	0
160671	0	30
280671	<1	0
190771	0	0
290771	0	0
170871	<1	0
310871	0	0
100971	<1	0
220971	1	<1
61071	M	M
201071	3	0
131171	0	<1
11271	0	0
121271	7	0
221271	7	0
120172	<1	<1
80272	0	0
220272	2	0
140372	2	<1

(Continued)

TABLE B-4 (CONTINUED)

Date	Fragilaria pinnata	Diatoma tenue var. elongatum
290372	<1	0
110472	0	0
270472	0	0
90572	0	0
210572	0	0
70672	0	0
210672	5	0
90772	0	3
250772	11	8
160872	0	0
240872	1	0
90972	1	0
230972	<1	0
41072	0	0
271072	0	<1

M = Data Missing

TABLE B-5. ABUNDANCE (IN FRUSTULES/ML) OF MAJOR DIATOMS SPECIES AT STATION 4, MAY 1970 - OCTOBER 1972

Date	Total Diatoms	Melosira italica	Rhizosolenia eriensis	Fragilaria capucina	Melosira islandica
270570	299	60	11	0	62
80670	M	M	M	M	M
160670	M	M	M	M	M
260670	1075	41	578	0	73
80770	M	M	M	M	M
200770	M	M	M	M	M
110870	871	0	0	6	0
210870	143	0	0	6	0
20970	228	0	0	2	0
140970	M	M	M	M	M
280970	M	M	M	M	M
81070	M	M	M	M	M
221070	162	1	1	2	0
31170	240	0	1	11	0
161170	M	M	M	M	M
281170	M	M	M	M	M
91270	580	4	<1	0	<1
221270	1120	15	<1	<1	2
60171	104	12	3	<1	2
190171	142	22	0	2	13
30271	126	36	0	0	11
110371	M	M	M	M	M
240371	66	20	0	0	10
60471	78	28	0	0	23
160471	85	34	<1	0	20
300471	83	29	0	0	38
110571	70	34	0	0	29
250571	116	37	0	0	62
30671	185	61	0	0	100
160671	142	54	0	0	44
280671	71	5	<1	1	7
190771	376	<1	0	3	0
290771	268	<1	0	0	0
170871	47	<1	0	0	0
310871	103	0	0	<1	0
100971	27	<1	0	0	0
220971	83	0	0	0	0
61070	M	M	M	M	M
201071	326	<1	0	0	0
131171	288	<1	0	1	<1
11271	74	2	0	<1	<1
121271	41	8	0	<1	2
221271	272	17	<1	0	2
120172	91	16	0	<1	3

(Continued)

TABLE B-5 (CONTINUED)

Date	Total Diatoms	Melosira italica	Rhizosolenia eriensis	Fragilaria capucina	Melosira islandica
80272	170	32	0	4	34
220272	219	33	1	0	16
140372	126	40	0	0	36
290372	103	42	0	0	27
110472	90	45	0	0	27
270472	61	31	0	0	14
90572	101	49	0	0	25
210572	166	92	<1	0	41
70672	214	126	0	0	59
210672	273	127	1	0	65
90772	271	17	13	0	5
250772	999	4	483	0	0
160872	592	2	0	0	0
240872	599	1	1	10	1
90972	369	<1	0	0	0
230972	120	<1	0	0	2
41072	39	1	0	0	<1
271072	120	1	<1	0	0

Date	Asterionella formosa	Cyclotella michiganiana	Tabellaria flocculosa	Synedra ulna	Fragilaria crotonensis
270570	17	1	6	6	23
80670	M	M	M	M	M
160670	M	M	M	M	M
260670	8	0	12	8	28
80770	M	M	M	M	M
200770	M	M	M	M	M
110870	3	71	0	0	0
210870	0	17	<1	0	0
20970	0	39	3	0	13
140970	M	M	M	M	M
280970	M	M	M	M	M
81070	M	M	M	M	M
221070	10	18	28	0	78
31170	22	10	53	0	107
161170	M	M	M	M	M
281170	M	M	M	M	M
91270	4	1	5	<1	20
221270	7	6	18	0	41
60171	8	2	9	0	29
190171	<1	3	26	1	24
30271	0	<1	16	<1	25
110371	M	M	M	M	M
240371	0	<1	5	0	11

(Continued)

TABLE B-5 (CONTINUED)

Date	Asterionella formosa	Cyclotella michiganiana	Tabellaria flocculosa	Synedra ulna	Fragilaria crotonensis
60471	0	<1	4	<1	5
160471	0	<1	6	1	8
300471	0	<1	4	<1	4
110571	0	<1	2	<1	0
250571	0	0	2	3	3
30671	0	0	4	7	4
160671	0	<1	4	6	14
280671	<1	<1	4	5	20
190771	15	27	2	2	289
290771	2	85	13	0	115
170871	<1	3	1	1	26
310871	2	6	2	0	5
100971	<1	<1	<1	0	5
220971	5	3	4	0	20
61070	M	M	M	M	M
201071	95	9	7	0	133
131171	28	19	17	<1	200
11271	2	4	6	0	53
121271	<1	3	2	0	18
221271	10	6	9	0	64
120172	4	3	5	0	32
80272	<1	3	24	<1	35
220272	5	3	2	<1	14
140372	0	0	<1	<1	1
290372	<1	2	11	0	4
110472	<1	1	5	1	2
270472	0	<1	4	<1	<1
90572	0	<1	7	1	2
210572	0	<1	3	4	2
70672	0	<1	2	2	2
210672	0	0	15	1	12
90772	15	0	8	5	43
250772	46	10	0	3	21
160872	2	4	2	0	72
240872	8	3	10	<1	463
90972	46	3	4	0	288
230972	18	2	7	0	64
41072	<1	<1	12	5	13
271072	24	4	29	0	37

Date	Cyclotella stelligera	Stephanodiscus minutus	Stephanodiscus hantzschii	Cyclotella comta	Fragilaria construens
270570	12	31	6	0	0
80670	M	M	M	M	M

(Continued)

TABLE B-5 (CONTINUED)

Date	Cyclotella stelligera	Stephan-odiscus minutus	Stephan-odiscus hantzschii	Cyclotella comta	Fragilaria construens
160670	M	M	M	M	M
260670	28	0	4	0	0
80770	M	M	M	M	M
200770	M	M	M	M	M
110870	613	27	10	0	3
210870	87	0	4	1	0
20970	145	0	2	2	0
140970	M	M	M	M	M
280970	M	M	M	M	M
81070	M	M	M	M	M
221070	11	0	1	3	0
31170	8	0	4	4	0
161170	M	M	M	M	M
281170	M	M	M	M	M
91270	4	2	4	<1	0
221270	4	0	<1	<1	0
60171	6	16	<1	0	0
190171	<1	0	1	<1	0
30271	2	2	<1	<1	0
110371	M	M	M	M	M
240371	1	0	0	0	<1
60471	2	0	0	0	0
160471	2	0	<1	0	0
300471	1	0	0	<1	0
110571	0	0	0	0	0
250571	0	0	0	<1	0
30671	<1	0	0	0	0
160671	1	0	<1	0	<1
280671	3	0	0	0	0
190771	18	0	0	<1	0
290771	42	0	0	6	0
170871	1	0	<1	13	0
310871	80	0	0	7	0
100971	14	0	2	2	<1
220971	38	0	4	2	0
61071	M	M	M	M	M
201071	10	0	12	4	17
131171	3	0	0	5	0
11271	<1	0	<1	2	0
121271	<1	0	0	<1	<1
221271	6	7	13	2	82
120172	4	0	<1	1	6
80272	2	2	<1	<1	1
220272	31	82	1	0	2

(Continued)

TABLE B-5 (CONTINUED)

Date	Cyclotella stelligera	Stephan-odiscus minutus	Stephan-odiscus hantzschii	Cyclotella comta	Fragilaria construens
140372	0	2	<1	0	9
290372	<1	0	0	<1	<1
110472	0	0	0	0	1
270472	1	0	0	0	<1
90572	2	4	0	0	0
210572	3	<1	0	<1	0
70672	2	2	0	0	0
210672	0	0	0	0	0
90772	39	0	0	0	0
250772	295	0	0	0	0
160872	429	0	0	17	0
240872	20	0	0	24	0
90972	12	0	0	4	<1
230972	8	0	0	10	3
41072	<1	0	0	4	0
271072	6	0	0	3	0

Date	Synedra radians	Stephan-odiscus alpinus	Melosira ambigua	Cyclotella ocellata	Fragilaria Sp. 1
270570	0	3	0	6	1
80670	M	M	M	M	M
160670	M	M	M	M	M
260670	0	16	32	4	0
80770	M	M	M	M	M
200770	M	M	M	M	M
110870	0	3	27	6	0
210870	0	1	1	0	0
20970	0	<1	2	0	0
140970	M	M	M	M	M
280970	M	M	M	M	M
81070	M	M	M	M	M
221070	0	0	<1	2	0
31170	0	6	<1	8	0
161170	M	M	M	M	M
281170	M	M	M	M	M
91270	0	4	<1	1	<1
221270	<1	4	3	4	0
60171	0	3	0	3	2
190171	3	20	<1	1	4
30271	<1	22	<1	3	0
110371	M	M	M	M	M
240371	<1	0	0	<1	2

(Continued)

TABLE B-5 (CONTINUED)

Date	Synedra radians	Stephan-odiscus alpinus	Melosira ambigua	Cyclotella ocellata	Fragilaria Sp. 1
60471	<1	10	0	1	<1
160471	3	4	0	1	<1
300471	<1	2	0	<1	<1
110571	0	1	0	<1	2
250571	<1	1	0	<1	3
30671	5	0	0	0	2
160671	7	<1	1	2	2
280671	14	<1	0	7	<1
190771	2	0	0	14	0
290771	0	0	0	4	0
170871	0	<1	<1	<1	0
310871	0	<1	0	0	<1
100971	0	<1	<1	<1	0
220971	0	<1	4	<1	0
61071	M	M	M	M	M
201071	0	3	14	0	0
131171	0	0	8	2	0
11271	0	1	<1	<1	<1
121271	<1	<1	<1	0	<1
221271	0	4	3	7	0
120172	0	5	0	3	4
80272	<1	13	2	5	4
220272	<1	15	0	2	1
140372	0	5	<1	3	2
290372	<1	2	0	3	2
110472	<1	1	0	2	1
270472	<1	1	0	<1	<1
90572	<1	2	0	3	1
210572	2	<1	0	7	4
70672	3	2	0	4	4
210672	22	2	0	7	9
90772	85	11	0	22	0
250772	75	4	0	32	0
160872	0	0	0	63	0
240872	1	0	0	52	0
90972	0	0	0	4	0
230972	0	<1	<1	4	0
41072	<1	11	0	4	<1
271072	<1	0	1	12	0

Date	Fragilaria pinnata	Diatoma tenue var. elongatum
270570	1	0
80670	M	M

(Continued)

TABLE B-5 (CONTINUED)

Date	Fragilaria pinnata	Diatoma tenue var. elongatum
160670	M	M
260670	0	4
80770	M	M
200770	M	M
110870	6	0
210870	0	0
20970	5	0
140970	M	M
280970	M	M
81070	M	M
221070	0	<1
31170	0	1
161170	M	M
281170	M	M
91270	1	0
221270	0	<1
60171	2	0
190171	1	0
30271	<1	0
110371	M	M
240371	0	0
60471	0	0
160471	0	0
300471	0	0
110571	0	0
250571	<1	0
30671	0	0
160671	0	<1
280671	0	1
190771	0	0
290771	0	0
170871	0	0
310871	0	0
100971	0	0
220971	2	0
61070	M	M
201071	6	0
131171	0	0
11271	0	0
121271	1	0
221271	14	0
120172	3	0
80272	<1	0
220272	2	0
140372	12	0

(Continued)

TABLE B-5 (CONTINUED)

Date	Fragilaria pinnata	Diatoma tenue var. elongatum
290372	4	0
110472	0	0
270472	<1	0
90572	0	0
210572	1	0
70672	0	0
210672	0	0
90772	0	2
250772	14	4
160872	0	0
240872	0	3
90972	<1	0
230972	0	0
41072	0	0
271072	0	0

M = Data Missing

TABLE B-6. ABUNDANCE (IN FRUSTULES/ML) OF MAJOR DIATOMS SPECIES AT STATION 5, MAY 1970 - OCTOBER 1972

Date	Total Diatoms	Melosira italica	Rhizosolenia eriensis	Fragilaria capucina	Melosira islandica
270570	1075	0	3	44	20
80670	M	M	M	M	M
160670	M	M	M	M	M
260670	1132	13	243	10	10
80770	M	M	M	M	M
200770	M	M	M	M	M
110870	494	0	2	43	0
210870	332	0	0	5	0
20970	364	<1	1	1	1
140970	M	M	M	M	M
280970	M	M	M	M	M
81070	M	M	M	M	M
221070	58	<1	<1	<1	0
31170	234	1	2	3	0
161170	M	M	M	M	M
281170	M	M	M	M	M
91270	98	5	2	3	<1
221270	104	6	0	<1	1
60171	221	9	1	2	2
190171	249	18	9	0	4
30271	130	27	0	<1	9
110371	M	M	M	M	M
240371	123	37	0	0	25
60471	104	37	0	0	43
160471	106	34	0	1	35
300471	78	30	0	0	31
110571	98	43	0	0	41
250571	136	38	<1	2	24
30671	95	9	0	5	1
160671	786	5	224	5	5
280671	288	2	0	9	0
190771	291	<1	0	0	0
290771	273	2	0	5	0
170871	352	0	<1	0	0
310871	M	M	M	M	M
100971	76	<1	0	9	<1
220971	104	1	<1	0	0
61070	80	<1	0	10	0
201071	130	<1	0	1	<1
131171	189	2	0	2	0
11271	195	5	0	<1	0
121271	244	5	0	2	<1
221271	110	6	<1	2	<1
120172	205	25	0	0	10

(Continued)

TABLE B-6 (CONTINUED)

Date	Total Diatoms	Melosira italica	Rhizosolenia eriensis	Fragilaria capucina	Melosira islandica
80272	77	22	0	0	15
220272	481	49	5	0	53
140372	116	42	0	0	40
290372	153	45	0	0	50
110472	900	33	0	0	36
270472	128	42	0	0	31
90572	239	59	0	2	33
210572	198	31	0	0	16
70672	198	55	0	5	21
210672	185	84	1	<1	46
90772	880	48	403	0	3
250772	680	16	54	20	0
160872	1152	0	164	0	0
240872	137	4	0	8	0
90972	171	<1	0	<1	0
230972	369	9	<1	0	<1
41072	53	3	<1	0	<1
271072	71	20	<1	<1	<1

Date	Asterionella formosa	Cyclotella michiganiana	Tabellaria flocculosa	Synedra ulna	Fragilaria crotonensis
270570	38	0	125	1	103
80670	M	M	M	M	M
160670	M	M	M	M	M
260670	17	0	296	3	325
80770	M	M	M	M	M
200770	M	M	M	M	M
110870	30	73	10	0	88
210870	6	54	6	0	38
20970	27	18	15	0	50
140970	M	M	M	M	M
280970	M	M	M	M	M
81070	M	M	M	M	M
221070	4	9	12	0	17
31170	15	20	28	0	100
161170	M	M	M	M	M
281170	M	M	M	M	M
91270	9	6	9	0	32
221270	<1	2	13	0	63
60171	16	0	4	0	56
190171	0	4	11	0	22
30271	<1	2	21	<1	32
110371	M	M	M	M	M
240371	0	<1	11	<1	19

(Continued)

TABLE B-6 (CONTINUED)

Date	Asterionella formosa	Cyclotella michiganiana	Tabellaria flocculosa	Synedra ulna	Fragilaria crotonensis
60471	0	0	4	<1	6
160471	0	<1	5	1	9
300471	0	<1	3	1	3
110571	0	0	3	2	2
250571	<1	0	18	10	28
30671	0	0	2	7	37
160671	226	2	29	7	147
280671	4	1	21	<1	224
190771	14	65	15	<1	157
290771	4	76	14	0	130
170871	1	7	4	0	25
310871	M	M	M	M	M
100971	4	2	2	0	15
220971	8	4	2	0	22
61070	4	4	6	<1	38
201071	7	13	3	0	56
131171	16	6	8	0	116
11271	18	9	11	0	128
121271	4	5	9	0	200
221271	6	6	6	<1	60
120172	13	2	16	<1	93
80272	<1	<1	9	0	14
220272	10	9	28	0	46
140372	0	<1	10	<1	3
290372	0	2	22	<1	7
110472	0	1	6	0	<1
270472	0	1	19	2	4
90572	0	2	39	4	25
210572	0	2	60	10	30
70672	0	<1	55	3	18
210672	<1	0	8	3	9
90772	42	0	10	2	22
250772	13	17	10	0	86
160872	24	40	8	4	16
240872	<1	3	14	0	82
90972	20	3	7	0	125
230972	58	2	20	0	227
41072	16	<1	8	0	24
271072	2	<1	7	0	16

Date	Cyclotella stelligera	Stephan-odiscus minutus	Stephan-odiscus hantzschii	Cyclotella comta	Fragilaria construens
270570	0	0	513	0	103
80670	M	M	M	M	M

(Continued)

TABLE B-6 (CONTINUED)

Date	Cyclotella stelligera	Stephan-odiscus minutus	Stephan-odiscus hantzschii	Cyclotella comta	Fragilaria construens
160670	M	M	M	M	M
260670	10	0	10	0	325
80770	M	M	M	M	M
200770	M	M	M	M	M
110870	165	0	0	2	0
210870	0	0	0	1	0
20970	0	0	3	1	50
140970	M	M	M	M	M
280970	M	M	M	M	M
81070	M	M	M	M	M
221070	6	0	1	<1	0
31170	13	0	3	3	0
161170	M	M	M	M	M
281170	M	M	M	M	M
91270	8	0	4	<1	0
221270	<1	0	<1	<1	0
60171	18	60	<1	0	0
190171	6	103	7	0	2
30271	<1	0	<1	<1	0
110371	M	M	M	M	M
240371	1	0	0	<1	0
60471	2	0	0	<1	0
160471	4	0	0	0	0
300471	0	0	0	0	0
110571	0	0	0	0	0
250571	0	0	5	0	0
30671	0	0	2	0	0
160671	34	0	34	0	0
280671	1	0	<1	0	0
190771	26	0	0	0	0
290771	34	0	0	2	0
170871	300	0	<1	0	0
310871	M	M	M	M	M
100971	24	0	6	5	1
220971	42	0	6	2	1
61071	7	0	0	2	0
201071	3	0	0	3	19
131171	1	0	<1	<1	0
11271	2	0	<1	2	128
121271	2	0	0	<1	2
221271	5	0	1	0	3
120172	1	0	1	2	11
80272	2	1	<1	<1	0
220272	23	184	19	0	3

(Continued)

TABLE B-6 (CONTINUED)

Date	Cyclotella stelligera	Stephan-odiscus minutus	Stephan-odiscus hantzschii	Cyclotella comta	Fragilaria construens
140372	0	<1	0	<1	0
290372	2	0	0	<1	<1
110472	<1	0	0	0	0
270472	<1	1	<1	0	<1
90572	3	18	2	0	2
210572	2	<1	2	0	1
70672	1	0	1	0	0
210672	1	0	0	0	0
90772	80	0	13	0	16
250772	100	26	6	0	30
160872	812	4	0	4	0
240872	1	0	<1	8	0
90972	3	0	0	7	2
230972	17	2	0	5	2
41072	8	0	0	3	0
271072	1	<1	<1	3	<1

Date	Synedra radians	Stephan-odiscus alpinus	Melosira ambigua	Cyclotella ocellata	Fragilaria Sp. 1
270570	0	0	53	6	0
80670	M	M	M	M	M
160670	M	M	M	M	M
260670	0	14	28	3	0
80770	M	M	M	M	M
200770	M	M	M	M	M
110870	0	2	5	2	0
210870	0	0	1	2	0
20970	0	4	4	3	0
140970	M	M	M	M	M
280970	M	M	M	M	M
81070	M	M	M	M	M
221070	0	0	<1	2	0
31170	0	1	17	2	<1
161170	M	M	M	M	M
281170	M	M	M	M	M
91270	0	8	3	<1	<1
221270	0	8	4	1	<1
60171	0	25	0	0	0
190171	0	18	3	0	4
30271	0	19	3	<1	2
110371	M	M	M	M	M
240371	<1	15	0	2	1

(Continued)

TABLE B-6 (CONTINUED)

Date	Synedra radians	Stephan-odiscus alpinus	Melosira ambigua	Cyclotella ocellata	Fragilaria Sp. 1
60471	1	4	0	2	3
160471	2	6	0	3	<1
300471	<1	1	0	1	4
110571	0	<1	0	<1	2
250571	3	<1	0	<1	1
30671	5	1	0	2	<1
160671	7	22	2	7	0
280671	2	<1	12	4	0
190771	0	2	<1	8	<1
290771	0	0	0	2	0
170871	0	<1	1	<1	7
310871	M	M	M	M	M
100971	0	<1	<1	<1	0
220971	<1	1	0	3	0
61071	0	<1	3	<1	0
201071	0	1	6	<1	<1
131171	0	1	30	<1	0
11271	0	7	6	2	<1
121271	<1	2	0	<1	<1
221271	0	7	<1	<1	<1
120172	0	12	<1	2	1
80272	0	6	0	1	2
220272	0	16	0	5	4
140372	<1	6	<1	2	4
290372	<1	6	0	4	5
110472	0	3	0	3	3
270472	0	3	0	7	7
90572	20	4	0	6	10
210572	27	2	1	6	<1
70672	20	2	0	8	1
210672	10	1	0	5	5
90772	64	48	0	29	7
250772	8	4	15	10	0
160872	8	0	0	68	0
240872	0	0	0	4	0
90972	0	0	0	2	0
230972	0	2	<1	2	<1
41072	0	<1	<1	2	<1
271072	<1	2	4	2	<1

Date	Fragilaria pinnata	Diatoma tenue var. elongatum
270570	0	18
80670	M	M

(Continued)

TABLE B-6 (CONTINUED)

Date	Fragilaria pinnata	Diatoma tenue var. elongatum
160670	M	M
260670	3	45
80770	M	M
200770	M	M
110870	0	0
210870	1	0
20970	7	0
140970	M	M
280970	M	M
81070	M	M
221070	0	<1
31170	0	<1
161170	M	M
281170	M	M
91270	<1	0
221270	0	0
60171	3	1
190171	2	<1
30271	2	0
110371	M	M
240371	<1	0
60471	0	0
160471	<1	<1
300471	0	0
110571	0	0
250571	<1	0
30671	0	<1
160671	0	27
280671	0	5
190771	0	0
290771	0	0
170871	0	0
310871	M	M
100971	<1	0
220971	1	0
61070	<1	M
201071	3	0
131171	0	0
11271	0	0
121271	2	0
221271	3	0
120172	9	0
80272	0	0
220272	0	1
140372	0	0

(Continued)

TABLE B-6 (CONTINUED)

Date	Fragilaria pinnata	Diatoma tenue var. elongatum
290372	0	0
110472	<1	0
270472	<1	0
90572	0	0
210572	0	0
70672	3	0
210672	0	0
90772	48	2
250772	4	0
160872	0	12
240872	<1	0
90972	0	0
230972	<1	0
41072	<1	<1
271072	0	0

M = Data Missing

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